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Background Document for Final Interstate Rail Carrier Noise Emission Regulation Source Standards

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16. ABSTRACT

This document details the scope, context, and breadth of work conducted in the development of the final noise emission regulation for four railyard sources: active retarders, locomotive load cell test stands, car coupling, and switcher locomotives. The Background Document discusses the physical and economic characteristics of the railroad industry, railroad equipment and facilities, baseline noise levels of railroad yard noise sources, "best available technology" to reduce noise emissions from railyard noise sources, results of the railroad yard noise propagation model and potential health and welfare benefits associated with various noise control measures, the costs attendant to noise control methods, and comments submitted to the docket.

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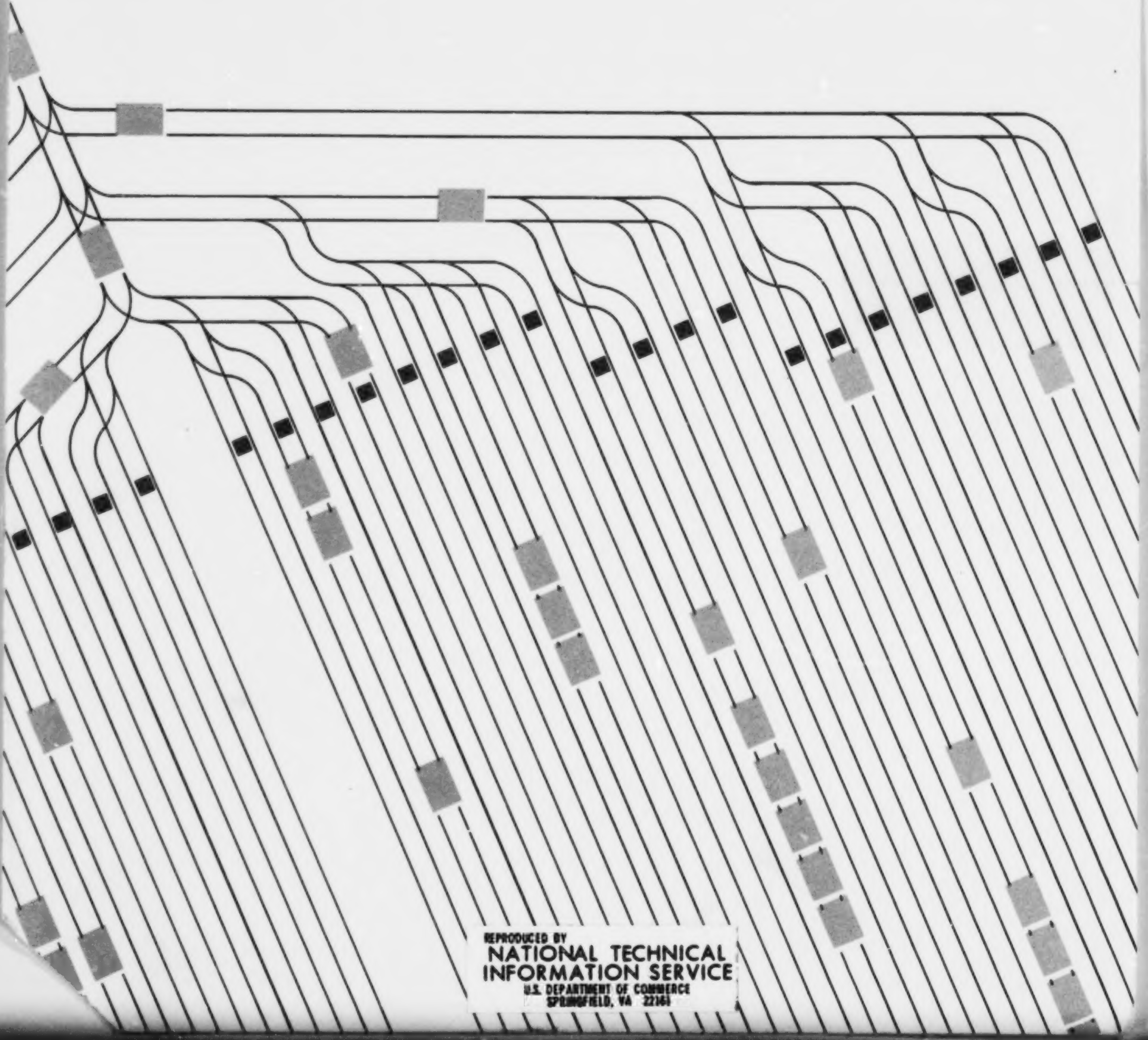

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December 1979

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency issued, on December 31, 1975*, a noise emission regulation for locomotives and railcars operated by interstate rail carriers (40 CFR Part 201). In developing the December 31, 1975 railroad noise emission regulation, EPA considered broadening the scope of the regulation to include facilities and additional equipment. Because of the wide disparity in perceived severity of noise problems found at differing rail facilities, the Agency decided that railroad facility and equipment noise, other than that produced by locomotives and railcars, was best controlled by measures which did not require national uniformity of treatment. Further, EPA believed that the health and welfare of the Nation's population being jeopardized by railroad facility and equipment noise, other than locomotives and railcars, was best served by specific controls at the state and local level and not by federal regulations, which would have to address railroads on a national, and therefore on a more general, basis. Where the Federal government establishes standards for railroad facilities and equipment, states and local authorities ordinarily are preempted unless they adopt standards identical to the federal standards. For these reasons, EPA decided to leave state and local authorities free to address site-specific problems, on a case-by-case basis, without unnecessary federal hindrance.

The Association of American Railroads (AAR) challenged the regulation on the grounds that it did not include sufficiently comprehensive standards for railroad equipment and facilities under Section 17 of the Noise Control Act of 1972 (Pub. L. 92-574, 86 Stat. 1234), and thus did not provide the rail carriers with adequate federal preemption of potentially conflicting state and local noise ordinances. The U.S. Court of Appeals for the District of Columbia Circuit ruled that EPA must substantially broaden the scope of its regulation affecting rail carrier facilities and equipment. On April 17, 1979* EPA proposed additional rules in response to this court order. The proposed standards were developed in terms of typical or average situations. Consequently the uniform national standards proposed were a compromise, only partially controlling railroad facility and equipment noise throughout the country. The primary factor limiting more effective federal noise control is the very substantial costs incurred when more stringent noise levels are applied on a nationwide basis to all railyards and equipment. The Agency's health and welfare analysis indicated that there would be an appreciable number of people in the nation who would still suffer significant adverse effects of railroad noise even after such a rule were in effect. Further, because of the preemptive nature of the federal regulation, states and localities would find it difficult to provide further relief to their citizens in most of these cases.

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*Published in Federal Register, Wednesday, January 14, 1976, pages 2184 to 2195.

The proposed regulation was published on April 17, 1979*, with a public comment period of 45 days. EPA extended the comment period by an additional 30 days, to July 2, 1979. Our review and analysis of the comments received, especially those regarding the availability of technology, costs associated with the property line standard, and the L_{dn} noise descriptor, have led us to divide our final regulation into two parts, each to be issued separately.

The first part, and the subject of this Background Document, concerns the immediate promulgation of noise emission limits for four railyard sources. These include two equipment sources, active retarders and locomotive load cell test stands, and one railyard operation, car coupling. Additionally, this action amends section 201.11 and 201.12 of the Rail Carrier Noise Emission Regulation (40 CFR Part 201) to provide for the control of switcher locomotive noise.

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*Published in Federal Register, Tuesday, April 17, 1979, pages 22960 to 22972.

The second part, the property line standard, will establish federal regulations limiting all other noise emitted from railyard facilities which are not covered by the source standards. This two-phased approach will allow EPA to satisfy the first part of the court order schedule agreement requiring promulgation of a source standard final rule by January 23, 1980. This two-phase approach allows more time to resolve the complex issues raised by the public comments concerning the property line standard.

This Background Document details the scope, context and breadth of the work conducted in support of the regulation. Section 2 characterizes the railroad industry from a physical and economic perspective. Section 3 identifies and classifies the railroad equipment and facilities studied, including railroad yard operations and activities. Baseline noise levels corresponding to specific railroad yard noise sources are described in Section 4. The "best available technology" to reduce noise emissions from the specified noise sources is also described in Section 4. Section 5 describes and details the results of the railroad yard noise propagation model and the potential health and welfare benefits associated with various noise control measures. Section 6 describes the costs attendant to noise control methods to achieve various regulatory study levels, and details the possible economic impacts. An analysis of comments submitted to the docket during the comment period is provided in Section 7.

SECTION 2

INDUSTRY PROFILE

INTRODUCTION

This section provides an overview of the railroad industry today. The industry structure is examined and the extent of existing competition within the railroad industry is evaluated. The railyard noise regulations are associated largely with the operation of railroad yards, but the economic impacts affect the entire railroad industry; consequently, the structural and financial characteristics of the industry will be examined since they will influence its ability to absorb the investment required for noise abatement fixes. Historical employment trends in the rail industry as well as the present level of employment and wages are also noted. Next, a variety of issues concerning competition in the transportation industry as a whole will be discussed, in particular, intermodal competition between railroads and trucks. A short discussion of the regulatory process and its effect on the railroad industry is followed by an evaluation of the overall performance of the railroad industry. The material presented in this section will establish a framework in which the problem of noise regulation within the railroad industry can be examined.

RAILROAD INDUSTRY STRUCTURE

In 1978, the U.S. railroad industry was composed of approximately 500 operating companies, which were divided into two categories. The first category consisted of 332 line-haul railroads providing freight and passenger service, and the second category contained 154 switching and terminal companies performing switching services, providing terminal trackage and facilities, and operating railroad bridges and ferries. For statistical reporting purposes, these railroads are divided into three classes by the Interstate Commerce Commission: Class I railroads having annual revenues of $50 million or more, Class II railroads with annual revenues of less than $50 million, and Class III railroads with revenues of less than $10 million.* Class I railroads incorporated 37 line-haul railroads, and Class II railroads another 12 roads, representing approximately 99 percent of the industry's traffic, 96 percent of its rail mileage, and 91 percent of its employment. There was also one Class I switching and terminal company and another 12 Class II switching and terminal companies.

At first glance, the structure of the railroad industry may appear more competitive than it actually is. Table 2-1 displays the largest companies in terms of total operating revenue**, freight operating revenue, employment and net income. Eight-firm concentration ratios computed for the 50 Class I and II railroads indicate that the top eight companies account for 61.3 percent of total operating revenues as well as freight operating revenues. The eight-firm concentration ratio for employment is 62.2 percent. Net income** of the largest firms ranked by operating revenues demonstrate that some of the largest companies are the least profitable. In particular, Consolidiated Rail Corporation, with a negative net income of $678 million is by far the largest single operating entity. However, high fixed costs** and massive capital expenditures** relative to operating revenues have resulted in large annual deficits. Of the eight largest firms in terms of operating revenues, six also rank in the top eight in terms of net income.

Yards and Equipment in the Railroad Industry

The 50 Class I and II line-haul railroads operate a total of 3,613 yards while Class I and II switching and terminal companies operate 83 yards. According to the inventory of railyards compiled by SRI,*** there are a total

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* The classification scheme was changed in 1978. Prior to 1978 Class I railroads had annual revenues of $10 million or greater. Class II railroads had less than $10 million annual revenues.

** See definitions of terms at the end of this section.

***S.J. Petracek, et al. Railroad Classification Yard Technology. Stanford Research Institute, Menlo Park, CA., January 1977.

Table 2-1

FIRMS RANKED BY TOTAL OPERATING REVENUES
(1978, $ IN MILLIONS)

Railroad	Total Operating Revenue*	Rank	Operating Revenue-Freight	Rank	Employment	Rank	Net Income	Rank
Consolidated Rail Corp.	3310 6	1	2812.5	1	91398	1	(678.0)	36
Burlington Northern Inc.	1976.4	2	1912.5	2	46684	2	86.9	6
Southern Pacific Trans. Co.	1653.9	3	1616.1	3	34643	3	36.0	10
Atchison, Topeka, & Santa Fe RR	1530.8	4	1491.3	4	33289	4	110.9	4
Union Pacific RR	1491.3	5	1465.6	5	26579	5	172.8	1
Missouri-Pacific RR	1198.1	6	1160.1	6	19812	7	135.7	3
Southern Railway System	1154.2	7	1120.7	7	21267	6	149.1	2
Norfolk & Western Railway	996.5	8	959.0	8	18984	10	86.0	7
Seaboard Coastline RR	910.5	9	881.0	9	19500	8	105.5	5
Baltimore & Ohio RR	830.7	10	792.6	10	16098	12	60.4	8
Louisville & Nashville RR	824.4	11	802.6	11	14994	13	23.8	14
Illinois Central Gulf RR	748.7	12	688.2	12	17094	11	3.2	29
Chesapeake & Ohio Railway	672.1	13	636.1	13	19236	9	21.7	15
Chicago & Northern Westerns by System	652.6	14	583.4	14	13523	14	2.2	30
Chicago, Milwaukee, St. Paul & Pacific RR	439.2	15	395.4	15	10833	15	(74.4)	35
Chicago, Rock Island, & Pacific RR	391.6	16	365.7	16	8280	16	(12.7)	34
St. Louis-San Francisco Railway	388.2	17	376.0	17	8270	17	38.0	9
Soo Line	251.3	18	245.6	18	4688	18	25.8	12
St. Louis Southwestern Railway	226.3	19	223.7	19	4200	20	32.7	11
Denver & Rio Grande Western RR	218.0	20	213.3	20	3525	21	25.5	13

*Excludes revenue from non-rail activities
Source: ICC R-1 Annual Reports

of 4,169 yards owned by all line-haul railroads, and switching and terminal companies; thus the smaller Class III railroads account for only 473 yards or 11.3 percent of the total. These facilities perform several functions for the railroad industry and are strategically located throughout the network. Table 2-2 characterizes these yard types and their functions by class. A classification yard receives, disassembles, reassembles and dispatches line-haul traffic. Industrial yards provide the freight interface between the railroads and other industries. Flat yards employ locomotive power for all car movements within a yard complex, while hump yards are designed to utilize a gravity-feed system to classify cars into departure configurations. As shown in these data, hump yards represent three percent of the current yard inventory. However, these are massive, expensive complexes that generally perform a variety of support services for the industry.

Table 2-2

U.S. RAILROAD YARDS IN 1978
BY CLASS I, II AND III RAILROAD COMPANIES BY YARD FUNCTION AND TYPE OF YARD

	CLASSIFICATION		INDUSTRIAL			
Class	Hump	Flat	Ind.	Sm Ind.	Total	Percentage
I & II	117	1,047	1,183	1,349	3,696	88.7
III	7	66	198	202	473	11.3
Total	124	1,113	1,381	1,551	4,169	100.0

Appendix C identifies individual railroads, the number of yards operated by each and the owning entity. Appendix F, Table F-3, tabulates the number of yards operated by each railroad by ICC Class designations in 1977 (Class I and II) and region (for Class I railroads). For each company the number of yards by type are tabulated and then summed. Table F-4 in Appendix F lists the roads which changed ICC Class designations between the years 1976 and 1977.

Railroad equipment in service at the end of 1978 is summarized in Table 2-3. The total number of refrigerator cars in service has been declining since 1974 from previous levels and is expected to continue falling. The trend in the size of the most numerous type of equipment, box cars and hoppers, has been toward greater freight tonnage capacity. Trends in ownership of cars have also been changing, with more privately owned cars leased to railroad operating companies. Finally, the total number of locomotive units operated by Class I and II railroads in 1978, and the total number of freight cars on-line, is summarized in Table 2-4.

Railroad Industry Employment

Employment in the railroad industry accounts for a large portion of costs. In 1978, total labor expenses were 43.9 percent of total Class I and II railroad operation revenues.* There has been a sharp decline in railroad employment caused in part by the changing role of railroads in the transportation market and in part by technological change incorporating more capital intensive technologies. Figure 2-1 is an historical time series of the level of employment. During the war years, employment reached a peak and declined thereafter. Since 1960, a relatively smooth decline of employment is depicted. In the past ten years, employment on Class I and II railroads had decreased by 18.5 percent. The level of employment for Class I and II railroads in 1978 was 471,516.

Even in the face of a declining demand for labor, annual payrolls, excluding fringe benefits, have risen by 78.6 percent in the past 10 years to $9.6 billion. Earnings per employee have more than doubled. In part, these payroll increases can be traced to the general rate of inflation existing in the economy, but they also reflect a complex interplay between railroads and unions in which increased productivity has been gained by reducing employment through attrition and laying-off nonessential workers.

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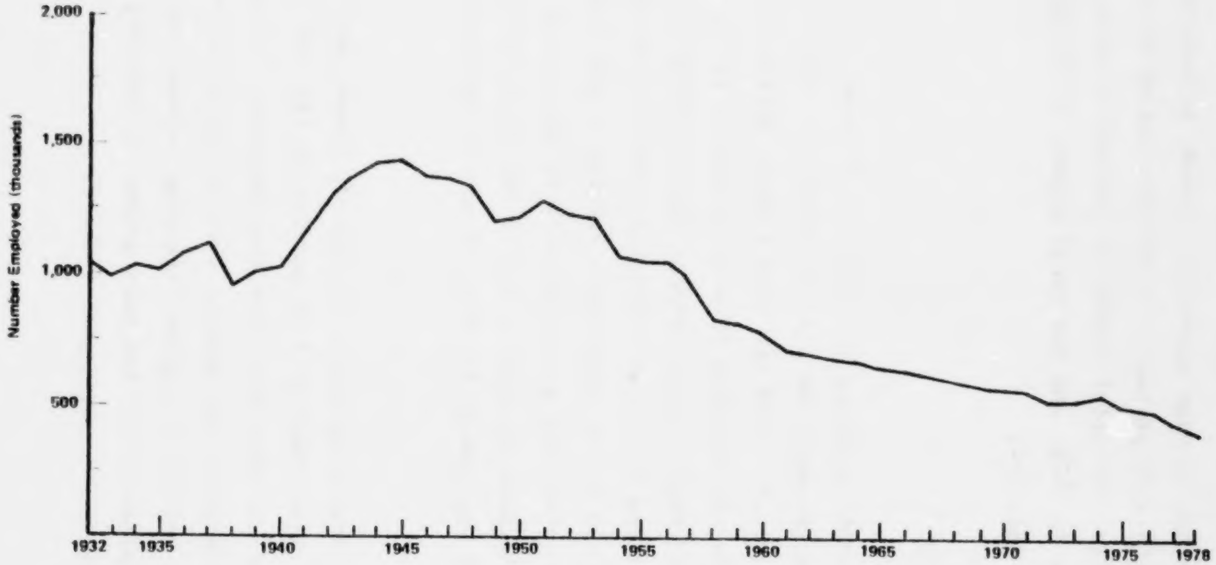
*Association of American Railroads, Yearbook of Railroad Facts, 1979 Edition.



NOTE: 1970-1974 is from STATISTIC ABSTRACT OF THE U.S., 1975 and 1976. Figures for 1975 and 1976 are estimated, based upon actual Class I employment.
SOURCE: Series 0398-409, RAILROAD EMPLOYMENT AND WAGES, AND ACCIDENTS AND FATALITIES; 1890-1970, HISTORICAL STATISTICS OF THE U. S. COLONIAL TIMES TO 1970

FIGURE 2–1. U. S. RAILROAD EMPLOYMENT, 1932–1978

Table 2-3

TYPES OF FREIGHT EQUIPMENT*

Type	Total	Class I Railroads	Other Railroads	Car Companies and Shippers
Box cars:				
Plain	262,986	217,307	32,335	13,344
Equipped	172,685	166,719	5,733	233
Covered hoppers	246,087	161,903	3,409	80,775
Flat cars	146,402	97,752	3,799	44,851
Refrigerator cars	87,601	68,059	3,648	15,894
Gondola Cars	175,777	158,680	5.240	11,857
Hopper cars	354,086	327,047	11,296	15,743
Tank cars	174,170	2,542	37	171,591
Other freight cars	32,980	26,491	3,384	3,105
Total	1,652,774	1,226,500	68,881	357,393

Source: Yearbook of Railroad Facts, 1979 Edition.

Table 2-4

LOCOMOTIVE AND FREIGHT CAR INVENTORY
CLASS I LINE HAUL RAILROADS (1977)*

District	Locomotives						Cars		
	Yard Service		Road Freight		Passenger		Freight		Passenger
	Total	Active	Total	Active	Total	Active	Total	Owned	Owned
Eastern	2,556	2,261	6,344	5,764	144	133	519,711	409,814	276
Southern	674	641	4,228	4,001	17	16	294,686	252,563	140
Western	2,642	2,444	10,311	9,484	180	156	640,677	520,385	766
TOTAL	5,882	5,346	20,883	19,249	341	305	1,455,074	1,182,762	1,182

Source: Association of American Railroads, Operating and Traffic Statistics, O.S. Series No. 220, 1978.

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*Note that these data sources were published in different years.

Cost of Providing Railroad Service

The railroad industry is characterized by a high proportion of fixed costs relative to total operating costs. In two similarly conducted studies* of total railroad operating costs, one for Class I railroads and the other for Class II railroads, fixed operating expenses were found to account for almost 60 percent of total costs.** Both of these studies sought to evaluate economies of scale in the industry; economies of scale** can be quite large when fixed operating costs are a large component of total costs. Both studies found that scale economies were attributable to economies of density rather than the size of the railroad (measured as miles of road).

Harris estimated that for railroads with densities of less than 250,000 ton miles per mile of road, truck service, even after accounting for the quality of service differential, was the cheaper transportation mode. He also concluded that for high density lines, costs of providing service were so much lower than costs on average density lines that comparing average costs of service between modes led to undue bias against railroads providing services on average density lines.

Sidhu, Charney and Due in their work were able to further decline the average cost of providing rail service. They found that average costs decreased very rapidly as traffic densities increased from 10,000 to 55,000 ton-miles per mile of road and continued to decrease fairly rapidly up to 200,000 ton-miles per mile of road. Economies of density continued to be realized until the lowest average cost was reached at about 10 million ton-miles per mile of road. Even at fairly light densities up to 200,000 ton-miles per mile, however, Sidhu found that railroads with a long enough haul could be cost competitive with trucks.

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* R.G. Harris, "Economics of Traffic Density in the Rail Freight Industry," Bell Journal of Economics 8 (Autumn 1977): and N.D. Sidhu, A. Charney, and J.F. Due, "Cost Functions of Class II Railroads and the Viability of Light Density Railway Lines," Quarterly Review of Economics and Business (Autumn 1977):

definitions of terms at the end of this section.

One can conclude from this discussion that high density railroads will be less severely affected by the added costs of railyard noise abatement investment if they are allowed to price according to marginal cost.* The problem of course is that railroads have been subject to minimum rate regulation since the early 1900s, where the minimum rate has been determined by the least efficient mode. The Railroad Revitalization and Regulatory Reform Act of 1976 is meant to allow railroads greater flexibility in determining rates. If railroads were able to price according to marginal cost of providing service, their significant economies of density would allow them to cover increased costs without adversely affecting their competitive advantage over trucks.

COMPETITION IN THE RAILROAD INDUSTRY

In evaluating the effect of firm concentration on the competitive behavior of the railroads, one should not overlook competition for transportation services arising in other industries, e.g., the trucking industry. Within the rail industry itself, competition may not appear to be substantial since individual roads are regulated by the ICC. It is evident, however, that in the broader market for transportation services, railroads do not possess a great deal of market power. Although each mode--railroads, trucks, barges, pipelines, etc.--possesses an advantage in a particular characteristic of service when compared with other modes, the various modes are generally viable, if imperfect, transportation substitutes.

A number of fairly recent studies have examined competition in the freight transportation industry to see whether rate de-regulation would result in benefits to the economy and what the relative impact on railroads and the trucking industry would be.** A common finding in all of these studies has been that modal shares are not particularly sensitive to price differentials but that they are sensitive to service differentials. (Service differentials have been computed as some combination of the value of the commodity shipped and mean transit time, a crude computation of inventory costs.) In Levin's study of 42 manufactured commodities, he found modal share to be between two and three times as sensitive to his service differential variable as to rate differentials.* He concluded, as did Boyer, that fairly substantial changes in rail freight rates would not lead to any marked shift between rail and truck. Thus freight rate increases which might result as a consequence of noise regulation should not induce any marked shift of commodities from rail to trucks. However, if noise regulations induce railyards to revise operations causing service changes, a shift to truck traffic could occur.

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*See definitions of terms at the end of this section.

**For example, see R.C. Levin, "Allocation in Surface Freight Transportation: Does Rate Regulation Matter?", Bell Journal of Economics 9 (Spring 1978): 18-45; and K.D. Boyer, "Minimum Rate Regulation, Modal Split Sensitivities, and the Railroad Problem," Journal of Political Economy 85 (June 1977): 493-512.

The "Industrial Shipper Survey" indicates shippers feel that railroads tend to provide inferior service compared to competing modes. Reasons for shippers' dissatisfaction with service included the following: 36 percent of all shippers found deliveries to be late; 35 percent found specified equipment was unavailable; 27 percent had to deal with late pick-ups; and 17 percent of shippers had shipments which were lost or damaged.**

Transit time generally does represent a measurable service differential. The more recently constructed highway system allows easy access to major highways which offer more direct routes to major cities. Thus transit time for trucks is inherently shorter. Direct capital investment is not required of trucking firms in highways and highway maintenance and, thus, operating costs are relatively lower than for railroads which must maintain their own road systems. Consequently, both the rate differential and the service differential in part can be traced to the implicit subsidy trucking firms receive.

Inland waterway carriers also compete for low-value bulk commodities. Their advantage also may be traced to implicit subsidies the inland waterways afford them and the absence of user charges for operation of the waterways.

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*Levin, Tables 7, 8, and 9, pp. 33-36.

**Prospectives for Change, p. 19.

In addition, technological advances which have allowed larger amounts of cargo to be shipped while at the same time reducing the number of crew members have resulted in a substantial differential between rail and barge rates.

Finally, pipelines pose an increasingly competitive challenge to railroads shipping crude oil and petroleum products. Unit costs for pipelines are much lower for high volume bulk commodities. Railroads simultaneously move their equipment with the goods being transported; consequently return loads must be found or the equipment will return empty, producing no revenue. Pipelines, of course, do not face a similar problem.

Table 2-5 shows transport statistics for selected years since 1929; it is apparent that railroads have lost a significant share of the freight market, and almost all of their passenger business. Railroads have surrended almost 20 percent of their share of all freight traffic to the trucking industry with a disproportionate loss in higher-value, low bulk commodities such as textiles, electrical machinery and equipment, medical instruments and food products. Waterways have captured some of the shipment of petroleum and coal products and stone and concrete products.

Table 2-6 shows the breakdown of commodities hauled by mode for 1972. With reference to revenue ton-miles, the railroads have been able to maintain a large share of the market, reflecting their advantage in long-haul, large volume or heavyweight shipments. Figure 2-2 indicates that railroads tend to have a commanding position, the longer the distance and the larger the shipment size. Even so, railroads have found their market share decreasing. Much of this loss is due to changes in taste and the existence of intermodal competition.

A major policy concern revolves around the question of whether strict regulation of the railroad industry is at all necessary or desirable in terms of efficiency of railroad industry operations. The ICC, created under the Act to Regulate Commerce, has been the guiding force over the railroads since 1887. At that time, the industry was highly profitable and offered the only means to

Table 2-5

TRANSPORT STATISTICS (1929-1978)

VOLUME OF U.S. INTERCITY FREIGHT AND PASSENGER TRAFFIC
Millions of Revenue Freight Ton-Miles and Percentage of Total

Year	Rail-roads[a]	%	Trucks	%	Great Lakes	%	Rivers and Canals	%	Oil pipe-lines	%	Air	%	Total
1929	454,800	74.9	19,689	3.3	97,322	16.0	8,661	1.4	26,900	4.4	3	—	607,375
1939	338,850	62.4	52,821	9.7	76,312	14.0	19,937	3.7	55,602	10.2	12	—	543,534
1944	746,912	68.6	58,624	5.4	118,769	10.9	31,386	2.9	132,864	12.2	71	—	1,088,266
1950	596,940	56.2	172,860	16.3	111,687	10.5	51,657	4.9	129,175	12.1	318	—	1,062,637
1960	579,130	44.1	285,483	21.7	99,468	7.6	120,785	9.2	228,626	17.4	778	--	1,314,270
1970	771,168	39.8	412,000	21.3	114,475	5.9	204,085	10.5	431,000	22.3	3,295	0.2	1,936,023
1974	855,582	38.6	495,000	22.3	107,451	4.9	247,431	11.2	506,000	22.8	3,580	0.2	2,215,044
1977	832,000	36.1	555,000	24.1	90,695	3.9	277,580	12.0	546,000	23.7	5,000	0.2	2,306,275
1978p	870,000	35.8	602,000	24.7	98,000	4.0	291,000	12.0	568,000	23.3	5,000	0.2	2,434,000

Millions of Revenue Passenger-Miles and Percentage of Total (Except Private)

Year	Rail-roads[a]	%	Buses	%	Air carriers	%	Inland Water-ways	%	Total (Except Private)	Private auto-mobiles	Private air-planes	Total (including private)
1929	33,965	77.1	6,800	15.4	--	—	3,300	7.5	44,065	175,000	—	219,065
1939	23,669	67.7	9,100	28.0	683	2.0	1,486	4.3	34,938	275,000	—	309,938
1944	97,705	75.7	26,920	20.9	2,177	1.7	2,187	1.7	128,989	181,000	1	309,990
1950	32,481	47.2	26,436	38.4	8,773	12.7	1,190	1.7	68,880	438,293	1,299	508,472
1960	21,574	28.6	19,327	25.7	31,730	42.1	2,688	3.6	75,319	706,079	2,228	783,626
1970	10,903	5.7	25,300	14.3	109,499	77.7	4,000	2.3	149,702	1,026,000	9,101	1,184,803
1974	10,475	5.9	26,700	15.1	135,469	76.7	4,000	2.3	176,644	1,143,440	11,000	1,331,044
1977p	10,400	5.1	25,900	12.7	164,200	80.3	4,000	1.9	204,500	1,234,500	12,100	1,451,100
1978p	10,500	4.6	25,000	10.9	190,000	82.8	4,000	1.7	229,500	1,298,000	15,000	1,542,500

a - Railroads of all classes, including electric railways, Amtrak and Auto-Train.
p - These are preliminary estimates and are subject to frequent subsequent adjustments.
NOTE: Air carrier data from reports of CAB and TAA; Great Lakes and rivers and canals from Corps of Engineers and TAA; some figures for 1977 and 1978 are partially estimated by AAR and TAA.

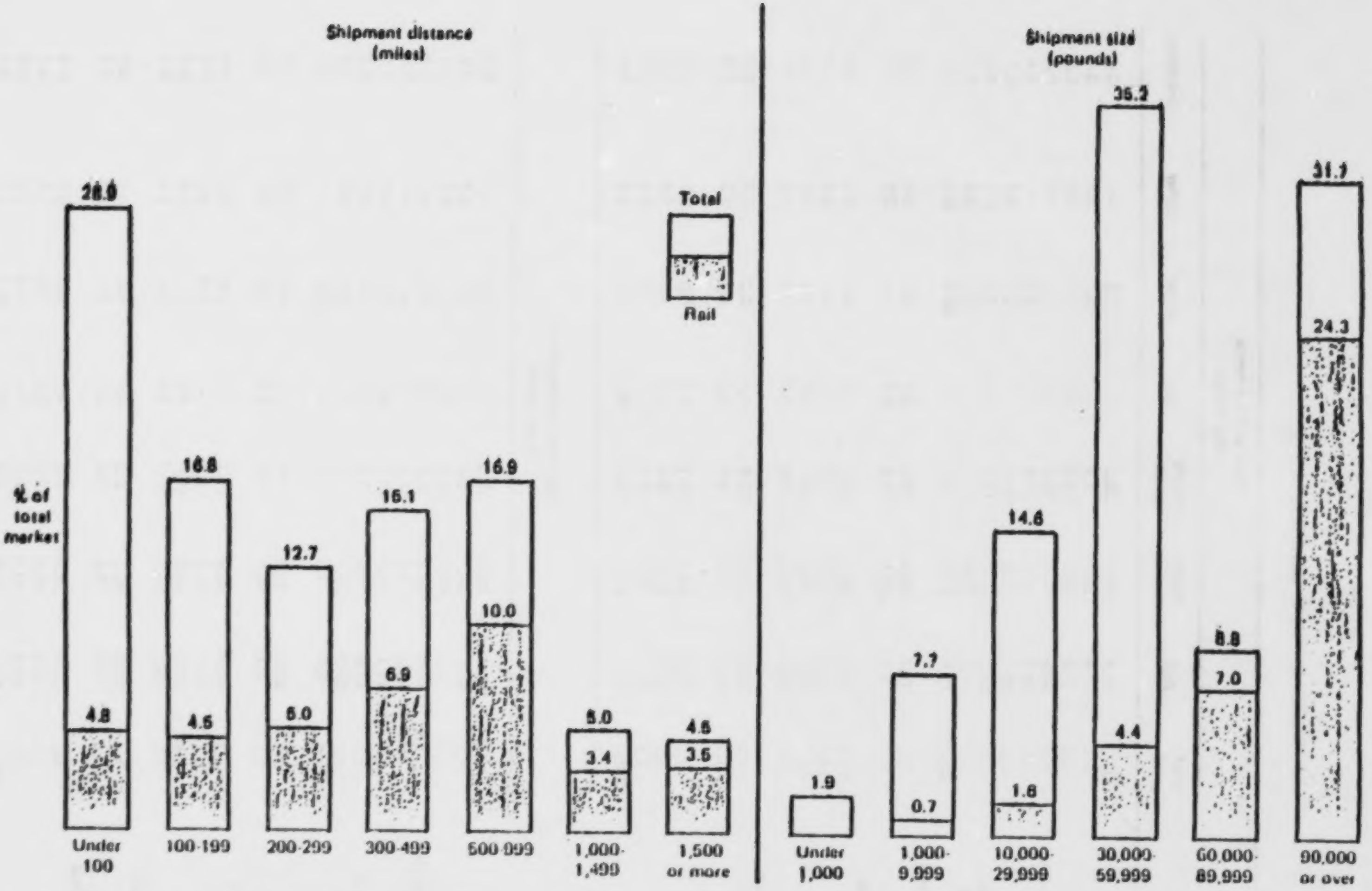
SOURCE: Yearbook of Railroad Facts, 1979 Edition, published by the Association of American Railroads.

Table 2-6

MODAL MARKET SHARES, 1972

Commodity	Tons of Shipments (%by mode)							
	% of total	Rail	Motor carrier	Private truck	Air	Water	Other	Unknown
Food and kindred products	27.0	37.4	25.0	33.9	–	3.5	–	0.4
Tobacco products	0.1	44.4	53.9	1.1	–	0.1	0.4	0.4
Textile mill products	1.0	8.5	63.5	27.3	0.2	–	0.6	0.2
Apparel and other finished textiles	0.4	10.0	68.5	15.2	1.9	–	4.5	0.2
Lumber and wood products	5.6	44.8	16.1	37.6	–	1.3	–	0.4
Furniture and fixtures	0.7	25.1	33.8	40.6	–	0.1	0.5	0.2
Pulp, paper, and allied products	5.9	52.1	27.7	17.9	–	2.2	0.1	0.2
Chemicals and allied products	11.6	42.0	33.5	11.3	–	12.7	0.6	0.2
Petroleum and coal products	23.2	11.5	16.1	8.3	–	63.8	0.2	0.4
Rubber and miscellaneous plastic products	1.2	23.4	60.4	15.1	0.7	0.1	0.4	0.3
Leather and leather products	0.1	2.4	61.1	31.8	0.3	–	3.9	0.7
Stone, clay, glass, and concrete products	11.3.	21.3	48.2	23.1	–	6.7	0.1	0.9
Primary metal products	10.7	42.1	43.6	9.9	–	4.1	0.4	0.2
Fabricated metal products	2.7	25.1	49.3	24.0	0.2	1.0	0.5	0.3
Machinery, except electrical	1.5	20.6	61.6	15.5	0.7	0.2	1.3	0.4
Electrical machinery, equip. and supplies	1.0	30.3	53.1	13.8	1.4	0.2	1.3	0.3
Transportation equip.	4.1	54.2	37.3	8.0	0.2	0.2	0.3	0.2
Instruments, photo, and medical goods	0.1	22.6	60.0	12.5	2.3	0.2	2.4	0.3
Mines, manufacture	0.3	20.3	51.8	19.2	0.9	4.2	3.0	1.0
All other misc.	1.7	67.9	12.7	17.3	–	1.9	0.2	0.3
U.S. total	100.0	31.7	31.2	18.3	0.1	18.4	0.3	0.4
	Ton-miles of shipments (% by mode)							
Food and kindred products	14.8	55.9	26.5	13.6	–	3.7	–	0.4
Tobacco products	0.1	64.1	34.5	0.3	–	0.7	0.5	0.2
Textile mill products	1.1	16.2	61.4	21.4	0.2	–	0.7	0.3
Apparel and other finished textiles	0.5	14.4	66.2	9.3	4.9	0.1	5.2	0.2
Lumber and wood products	7.1	76.6	7.7	11.0	–	4.7	–	0.3
Furniture and fixtures	0.8	41.1	32.9	25.2	0.1	0.3	0.5	0.1
Pulp, paper, and allied products	6.3	73.9	19.0	5.5	–	1.4	0.1	0.3
Chemicals and allied products	11.9	51.5	23.1	4.9	0.1	20.1	0.3	0.3
Petroleum and coal products	29.6	9.0	3.5	1.7	–	85.9	–	0.2
Rubber and miscellaneous plastic products	1.4	33.5	55.5	9.4	1.0	0.3	0.3	0.2
Leather and leather products	0.1	2.7	75.7	14.8	0.9	0.2	5.1	1.0
Stone, clay, glass and concrete products	5.3	45.5	36.4	11.2	–	6.4	0.1	0.6
Primary metal products	8.1	54.1	34.0	6.2	–	5.5	0.2	0.2
Fabricated metal products	2.6	37.2	49.0	10.7	0.5	2.0	0.5	0.4
Machinery, except electrical	2.1	29.2	60.0	7.7	1.4	0.4	1.4	0.4
Electrical machinery, equip. and supplies	1.4	37.6	49.5	8.2	2.6	0.6	1.4	0.4
Transportation equip.	5.3	75.8	18.6	4.8	0.3	0.3	0.3	0.3
Instruments, photo, and medical goods	0.2	36.8	50.5	6.2	4.1	0.3	2.2	0.3
Mines, manufacture	0.5	35.2	46.6	11.8	2.2	1.2	2.6	0.7
All other misc.	0.8	76.5	10.7	8.7	–	3.5	0.2	0.6
U.S. Total	100.0	42.1	20.9	6.9	0.2	29.7	0.3	0.3

NOTE: Dash Line Indicates insignificant or nonexistent amount
SOURCE: Department of Commerce, Commodity Transportation Survey, 1972 Census of Transportation, Area Report 8. United States.



NOTE: Excludes petroleum and coal products (TCC 29).
SOURCE: American Trucking Association, Department of Economics. Data were compiled from 1972 Census of Transportation. Commodity Transportation Survey, Department of Commerce.

FIGURE 2-2. RAIL FREIGHT MARKET FOR INTERCITY MANUFACTURERS, 1972

ship large quantities of freight between cities efficiently. The early industry was characterized by predatory pricing practices as individual firms fought to monopolize their particular markets. Many inequities in pricing policies arose. Often it was the case that rates on long distance hauls were lower than for short intercity trips because there often were alternative routes between major cities and thus rates were competitive. Between smaller cities only one road offered service and thus rates could be set considerably higher without losing business. As a result of pricing instability, inequities in service and the frequent bankruptcies of smaller roads, the ICC began to regulate company entries into the market in the early 1900s.

The ICC has played an influential role in the operations of railroads. Rate structures are determined by the agency. Value of service pricing, as practiced by the railroads, where highly valued goods are charged higher rates and lower valued goods lower rates, independently of real transporation cost, became the norm. However, as these pricing practices were modified, railroads lost the flexibility to respond to competition from other modes. Consequently, railroads lost most of their high value, low bulk markets and were left with the low value, high bulk commodities which they now haul. The Railroad Revitalization and Regulatory Reform Act of 1976 (4F Act) has sought to free the railroads from minimum rate regulation and to allow them to price according to the costs of providing service. However, the act has a number of terms not defined by Congress and must await interpretation by the courts before its full impact will be felt.*

RAILROAD INDUSTRY PERFORMANCE

Revenue Ton-Miles and Prices

Traffic statistics summarized in Table 2-7 suggest a steady increase in revenue ton-miles, although there was a slight decrease in the 1974-75 recession. In 1977 revenue ton-miles totaled 826.3 billion and increased further in 1978 to 858.1 billion ton-miles. Factors contributing to continued growth in

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*Prospectives for Change, p. 7.

Table 2-7

REVENUE TON-MILES

(TON-MILES IN MILLIONS)

	United States	Eastern District	Southern District	Western District
1967	719,498	258,361	127,988	333,149
1968	744,023	259,392	130,686	353,946
1969	767,841	259,827	139,256	368,757
1970	764,809	254,467	140,034	370,309
1971	739,743	225,619	139,660	374,464
1972	776,746	231,221	147,116	398,410
1973	851,809	245,022	157,879	448,907
1974	850,961	248,398	160,668	441,895
1975	754,252	217,909	140,261	396,083
1976	791,413	216,267	151,076	424,070
1977	826,292	211,278	160,689	454,326
1978	848,105	197,633	162,417	498,056

Source: Yearbook of Railroad Facts, 1979, Association of American Railroads, Washington, D.C.

revenue ton-miles include the installation of larger, specialized freight cars, the retirement of smaller cars and a longer average haul. However, service growth has not been uniform; the Eastern District experienced an 6.5 percent decline in ton-miles while the Southern and Western Districts realized 1.1 percent and 9.6 percent increases, respectively.

Table 2-8 shows that the average revenue per ton-mile has increased steadily over the twelve years between 1967 and 1978. Average revenue per ton-mile increased by 3.7 percent in 1978 resulting in an average of 2.370 cents, a total increase of 86.8 percent since 1967. However, prices of transportation services in general have risen by 109.4 percent over the same period. Average revenues from railroad transporation services have not kept pace with the general rate of inflation. They reflect the continued loss of high value, low bulk commodities and gains in low value, high bulk commodities.

Profitability

While revenue ton-miles and average revenues have been rising slowly over the last decade, profits have been falling since 1966. The rate of return on net investment for the industry has consistently remained below 3 percent. Table 2-9 shows that the rate of return on net investment* for the industry was only 1.62 percent in 1978. Comparing the railroad industry with other transportation industries in Table 2-10, the rate of return on equity* is shown to be extremely low both in absolute and relative terms. Class I line-haul railroads had a -0.41 percent rate of return on equity, while their competitors all enjoyed returns in excess of 10 percent.

New Technology

The railroad industry has been one characterized by slow technological change since the turn of the century. Innovations have resulted in more capital-intensive transportation service; this has led to an absolute decline in the number of employees as capital was substituted for labor. On the other

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* See definitions of terms at the end of this section.

Table 2-8
AVERAGE REVENUE PER TON-MILE
(CENTS PER TON-MILE)

	United States	Eastern District	Southern District	Western District
1967	1.269	1.336	1.152	1.262
1968	1.310	1.406	1.212	1.277
1969	1.347	1.452	1.255	1.309
1970	1.428	1.554	1.343	1.374
1971	1.593	1.831	1.478	1.493
1972	1.618	1.855	1.510	1.521
1973	1.617	1.881	1.526	1.504
1974	1.853	2.136	1.717	1.743
1975	2.041	2.372	1.879	1.913
1976	2.194	2.627	2.027	2.034
1977	2.286	2.800	2.113	2.109
1978	2.370	2.988	2.292	2.149

Source: Yearbook of Railroad Facts, 1979, Association of American Railroads, Washington, D.C.

Table 2-9

RATE OF RETURN ON NET INVESTMENT

	United States	Eastern District	Southern District	Western District
1967	2.46	1.58	3.86	2.75
1968	2.44	1.27	3.79	3.01
1969	2.36	1.10	4.17	2.81
1970	1.73	def.	4.50	3.02
1971*	2.12	def.	4.36	3.51
1972*	2.34	0.11	4.61	3.34
1973*	2.33	0.07	4.61	3.30
1974*	2.70	0.46	4.73	3.66
1975*	1.20	def.	3.98	2.65
1976*	1.49	def.	4.62	3.57
1977*	1.60	def.	5.23	3.71
1978	1.62	def.	5.44	4.40

def. --Deficit.

* Reflects inclusion of deferred taxes.

Source: Yearbook of Railroad Facts, 1979, Association of American Railroads, Washington, D.C.

Table 2-10

RATE OF RETURN ON REGULATED FREIGHT CARRIERS FOR THE YEAR 1975

Carrier	Return on Net Investment	Return on equity (net income basis)
Class I line-haul railroads[a]	0.08	-0.41
Class I intercity motor carriers of property	13.27	13.08
Class A and B water carriers by inland coastal waterways	15.79	20.18
Pipeline companies	7.66	21.19

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[a] By reason of the railroad industry's use of replacement retirement betterment (RRB) accounting for its rights-of-way, the rate of return for railroads cannot be compared directly with rates of return for other industries. Adjustment of the rail rate to reflect this difference would not change the indicated conclusion.

SOURCE: Interstate Commerce Commission, "90th Annual Report, Fiscal-Year Ending June 30, 1977," Tables 20, 12, and 15.

hand, partially due to regulation by the ICC, some innovations have been postponed and subsequently introduced only after long delays and long after they were justified on a cost basis. As an example, the "Big John" grain rate case of the Southern Railway between 1962 and 1965 was one which impeded the installation of 100 ton grain hopper cars for use in hauling grain at much lower rates. Likewise, unit trains were not allowed generally until the 1960s, although they were first introduced in 1930. Consequently, other transportation modes such as trucks, barges and pipelines, which have proven more flexible, have enjoyed some growth at the expense of railroads.

CONCLUSION

Several points are extremely important insofar as they affect the railroad industry's ability to absorb added costs of railyard noise regulation.

1. Railroads have experienced extremely low rates of return over the past decade, with no relief in sight. Fixed operating expenses are high as a result of the extreme capital intensity of railroad operations, and thus railroads will have difficulty raising funds internally for any investment not associated with operations. With their low rates of return, railroads also will have difficulty raising funds externally for any purpose. Thus, the financial stability of the railroads may be extremely sensitive to any increased costs.

2. The demand for railroad freight transportation services is not very sensitive to price differences between railroads and trucks. At the same time, the trucking industry is now subject to noise regulations, and thus its operating costs can be expected to increase. Consequently, one need not be overly concerned that price increases which may be allowed will lead to a worsening competitive position for railroads if costs increase as a result of noise regulation. On the other hand, because modal shares are affected by the quality of service, one should be sensitive to any time delays that new noise regulations may induce. These could lead to greater shifts in demand to trucks or other modes.

3. There are definite differences in industry strength on a regional basis. Eastern District railroads account for the bulk of the bankrupt railroads and those with extremely low rates of return. Southern and Western District railroads are in better shape financially although as a group their rates of return rank them among the lowest in U.S. industry. However, on a regional basis the Southern and Western District railroads will be better able to absorb increased costs brought about by noise regulation.

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DEFINITIONS OF TERMS

Capital Expenditure: The purchase of fixed assets (e.g., plant), expenditure on current assests (e.g., stocks).

Economies of scale: Exist when an increase in output results in a less than proportional increase in costs.

Equity: The value of a company's assets after allowing for all outside liabilities (other than to shareholders). Rate of return on equity is net profit after depreciation and taxes as a percentage of equity.

Fixed cost: Costs that, in the short run, do not vary with output. These costs are incurred even if no output is produced.

Marginal costs: The change in the total costs of production when output is varied by one unit. Marginal cost pricing is a method of pricing in which price is made equal to marginal costs. Maximum economic efficiency dictates that price be set at the point where all output services are sold at a price equaling the marginal costs of production. Since marginal costs vary with output, marginal costs pricing implies setting the price at the point which the demand curve cuts the marginal cost curve. In a perfectly competitive market a business would have to use marginal cost pricing to successfully sell it goods.

Net income: Net profit on earnings after tax.

Net investment: Measures the change in the capital stock. Calculated as the gross expenditure on capital formation minus the amount required to replace worn out and obsolete equipment. Rate of return on net investment is net profit after depreciation as a percentage of net investment.

Total costs: The summation of total fixed costs and total variable costs.

Total operating revenue: Value of services sold (price times quantity sold) for all rail activities.

SECTION 3

IDENTIFICATION AND CLASSIFICATION OF RAILROAD EQUIPMENT AND FACILITIES

INTRODUCTION

The purpose of this section is to identify the equipment and facilities of the railroad industry and to organize them into a logical classification system. The identification of the equipment and an understanding of its physical characteristics and usage will permit an effective and efficient assignment of noise abatement techniques to the proper sources.

The classification of facilities into various categories is in recognition of the fact that there is a wide variation in the noise impacts from differing types of facilities and equipment. Since there are several thousand railroad facilities -- far too many to analyze individually -- the facilities will be categorized into groups which have similar functions or characteristics with respect to their estimated noise impacts. The assessment of noise impacts and the potential costs for noise abatement can then be estimated separately for facilities having differing equipment types, operating characteristics, levels of activity, adjacent land uses and other factors which may significantly affect noise impacts and costs.

RAILROAD EQUIPMENT AND FACILITIES

Railroad property consists of equipment and facilities. Equipment includes locomotives, cars, and special purpose items such as for maintenance-of-way, loading and unloading of freight and marine applications. Facilities consist of track, tunnels, bridges, yards and a host of general or special purpose buildings.[1] Table 3-1 presents a list of the major items of railroad property.

The property, shown in general terms in Table 3-1, may be expanded by the type or function of each item. For example, there are four types of rail lines

Table 3-1

RAILROAD PROPERTY

FACILITIES

Lines (Track)
Tunnels
Bridges
Trestles
Culverts
Elevated Structures

Stations
Office Buildings
Service Facilities
Repair Facilities
Manufacturing Facilities
Testing Facilities

Power Generating Facilities
Communication Facilities
Freight Terminals
Marine Terminals
Flat Yards
Hump Yards
Power-Transmission Facilities

PRINCIPAL EQUIPMENT

Locomotives
Cars
Special Purpose Equipment (including Marine)

---

described by annual traffic density (i.e, A Main, B Main, A Branch and B Branch). Table 3-2 indicates that two basic types of locomotives, diesel and electric, perform four functions.[2] Table 3-3 shows that railroad freight cars fall into nine functional categories.[3]

Special purpose cars and equipment such as for marine applications and maintenance-of-way are listed in Table 3-4.[3] Although this tabulation may not be all inclusive, it reflects the majority of the inventory typical of railroad property.

The functions of railroad yards are: classification, storage, interchange, trailer/container on flatcar handling and local switching/industrial interfacing.[4,5] These facilities employ locomotive power for freight equipment movement through the yards (flat yards) or they can rely in part on gravity and yard grades for car movement through portions of the yard complex (hump yards).

Table 3-1 contains other types of facilities which are not covered under lines and yards. These are stations, terminals and isolated facilities which perform support functions. Stations and terminals include freight, passenger and marine facilities. Support facilities cover such functions as service and repair, power generating and transmission, and manufacturing and testing.[1]

CLASSIFICATION OF RAILROAD PROPERTY

Table 3-5 summarizes the items presented in the preceding subsection and suggests that all railroad property be grouped into four categories: lines, stations/terminals, yards and isolated support facilities. Each category is divided into several types of property. The principal equipment which operates in, or on, each of the four categories of property is also listed. Although other types of railroad equipment may be associated with each of the properties shown, this tabulation includes only principal items of railroad property.

Table 3-2

RAILROAD LOCOMOTIVES

Type	Function
Diesel	Road Passenger Road Freight Road Switcher Yard Switcher
Electric	Road Passenger Road Freight Yard Switcher
Steam	Generally Historic

Table 3-3

RAILROAD CARS (GENERIC TYPES)

Box Car
Refrigerator Car
Stock Car
Gondola Car
Hopper Car
Flat Car
Tank Car
Caboose
Special Purpose Car

Table 3-4

SPECIAL PURPOSE CARS AND EQUIPMENT

- Ballast Cribbing Machines
- Belt Machines
- Brush Cutters
- Compactors
- Welding Machines
- Snow Plows
- Spike Pullers
- Crosstie Replacers
- Cranes
- Spike Drivers
- Ballast Tampers
- Rail Aligners
- Ballast Cars
- Crosstie Cars
- Weed Sprayers
- Ditching Car
- Rail Saw
- Rail Bender
- Track Layer
- Caboose and Tool Car
- Dump Car
- Ballast Spreader and Trimmer
- Flat Car
- Track Inspection Car
- Hand Car
- Ballast Unloader
- Snow-Removing Car
- Store-Supply Car
- Pile Driver
- Steam Shovel
- Tool and Block Car
- Derrick
- Boarding Outfit Car
- Car Ferries
- Car Floats
- Tugs

Table 3-5

CLASSIFICATION OF RAILROAD PROPERTIES

Category of Railroad Property	Type of Railroad Property	Associated Principal Equipment
Lines	"A" Main ≥ 20M* "B" Main 5-20M* "A" Branch 1-5M* "B" Branch < 1M*	Locomotives Railcars Special Purpose Equipment
Stations/Terminals	Freight Passenger	Locomotives Railcars Special Purpose Equipment
	Marine	Ferries Floats Tugs
Yards	Hump Flat	Locomotives Railcars Special Purpose Equipment
Support Facilities	Service Repair Manufacturing Testing Power Generating Power Transmission Communication	

*M = millions of gross ton-miles per year

CLASSIFICATION SYSTEM FOR RAILROAD YARDS

The preceding discussion indicates that there are two principal types of yards in the railroad system, (i.e. hump and flat). There are, however, several subtypes of yards within each principal type. These subtypes are defined by function and activity level. Also, the number of railyards in each subtype has been determined according to place size (population in the locality of the yard) and a subjective judgment of predominant type of land use around the yards.

The two primary functions of railroad yards are the disassembly and reassembly of line-haul trains (classification yard) and the collection and distribution of cars to provide freight service to and from other industries (industrial yard).[4,5]

The primary land uses adjacent to the locations of railroad yards are:

- Industrial
- Commercial
- Residential
- Agricultural
- Undeveloped

The activity levels determined in terms of railcars classified per day for both principal types of yards are presented in Table 3-6.[4] It should be noted that these activity levels only apply to yards performing the classification function. They do not apply to those yards whose only function is freight service to and from industry (i.e., industrial yards). Also, six population size classes are used to describe or categorize the yards by locality. These are:[4]

- 0-5000 people
- 5,000-50,000 people
- 50,000-100,000 people
- 100,000-250,000 people
- 250,000-500,000 people
- >500,000 people

Table 3-6

ACTIVITY LEVELS FOR RAILROAD YARDS

Yard Type	Yard Activity	Number of Cars Classified per Day
Hump	Low	<1000
	Medium	1000-2000
	High	>2000
Flat	Low	< 500
	Medium	500-1000
	High	>1000

The system for the classification of railroad yards is summarized in Table 3-7.

The results of the identification and classification of railroad equipment and facilities indicated that railroad yards can also be categorized into four functional types:[4]

- Classification (C) Yards
- Classification/Industrial (C/I) Yards
- Industrial (I) Yards
- Small Industrial (SI) Yards.

In conducting the railyard noise impact assessment, it is useful to group all hump yard complexes (which include C, C/I, and I yards) into one category, which is referred to generally as hump classification yards, and to group all flat classification and classification/industrial yards into one general category of flat classification yards. The flat industrial yards and the flat small industrial yards are grouped as separate categories. Thus, the four basic railyard categories used in the noise impact model are:

- Hump Classification Yards
- Flat Classification Yards
- Flat Industrial Yards
- Flat Small Industrial Yards.

Additional details of activity rates and parameters for hump and flat classification yards are presented in Tables N-1 and N-2 in Appendix N.

DESCRIPTION OF TYPICAL RAILROAD YARDS

Hump Yards

Hump yards perform classification and may perform industrial service functions for U.S. railroads. This type of yard generally consists of a subyard to receive incoming line-haul traffic, a subyard where these trains are broken up and reassembled into outbound configurations and a subyard for outbound traffic. These three subyards are defined as receiving, classification and departure "yards" respectively, as shown below in Figure 3-1.[5]

Table 3-7

CLASSIFICATION SYSTEM FOR RAILROAD YARDS

YARD CHARACTERISTIC		Legend
Yard Type:	Hump	(H)
	Flat	(F)
Yard Function:	Classification	(C)
	Industrial	(I)
	Classification/Industrial	(C/I)
Adjacent Land Use:	Industrial	(I)
	Commerical	(C)
	Residential	(R)
	Agricultural	(A)
	Undeveloped	(U)
Yard Locality:	0-5000	(1)
Population Size Class:	5000-50,000	(2)
	50,000-100,000	(3)
	100,000-250,000	(4)
	250,000-500,000	(5)
	>500,000	(6)

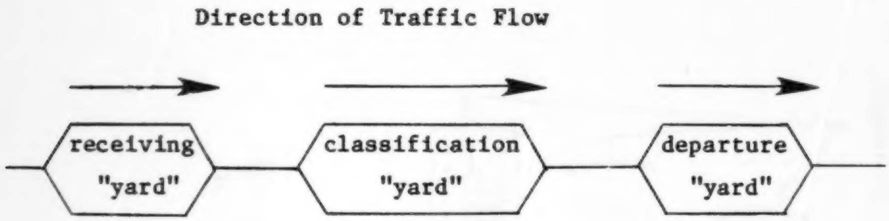


FIGURE 3-1. SCHEMATIC REPRESENTATION OF HUMP CLASSIFICATION YARD

The unique characteristic of hump yards is that they employ a gravity-feed system between the receiving subyard and the classification subyard. This system consists of a hump crest and a series of retarders for car spacing and speed control. This feature of all hump yards is shown in plan and elevation view in Figure 3-2.[5] Not shown are the "inert" retarders which are located at the departure end of each classification track. It should be noted that some hump classification yards also contain approach retarders (upstream of the hump crest), tangent point retarders (downstream of the group retarders at the origin of each classification track) and intermediate retarders (between the master and group retarders). A description of these retarding devices is contained in Section 4 of this document.

A typical hump yard may also contain a variety of buildings and facilities, such as:

- Control Tower(s) and Office/Administration Buildings
- Stock Pens
- Trailer Ramp
- Powerhouse
- Compressor Building
- Hydraulic Pump House
- Fuel Pump House
- Car One Spot Service and Repair Facility
- Caboose Service Facility
- Locomotive Washer Facility
- Locomotive Service Facility
- Maintenance-of-Way Facility

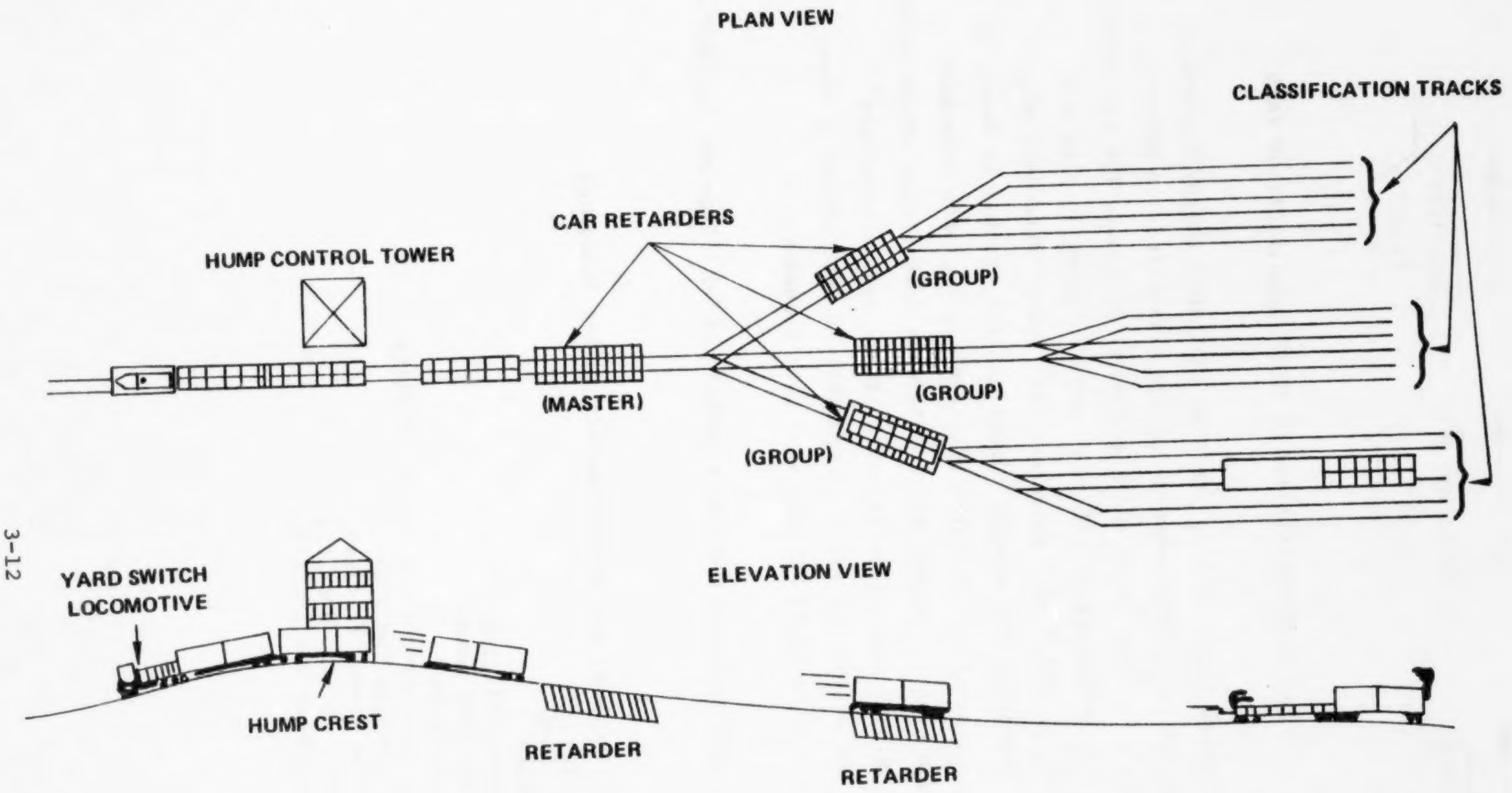


FIGURE 3–2. HUMP YARD CREST AND RETARDER SYSTEM

All types of locomotives can generally be found operating or undergoing service, maintenance, and perhaps, repair in hump yards. Further, all types of freight cars pass through hump yards and many of the way maintenance machines may be employed in, or housed on, hump yard complexes.

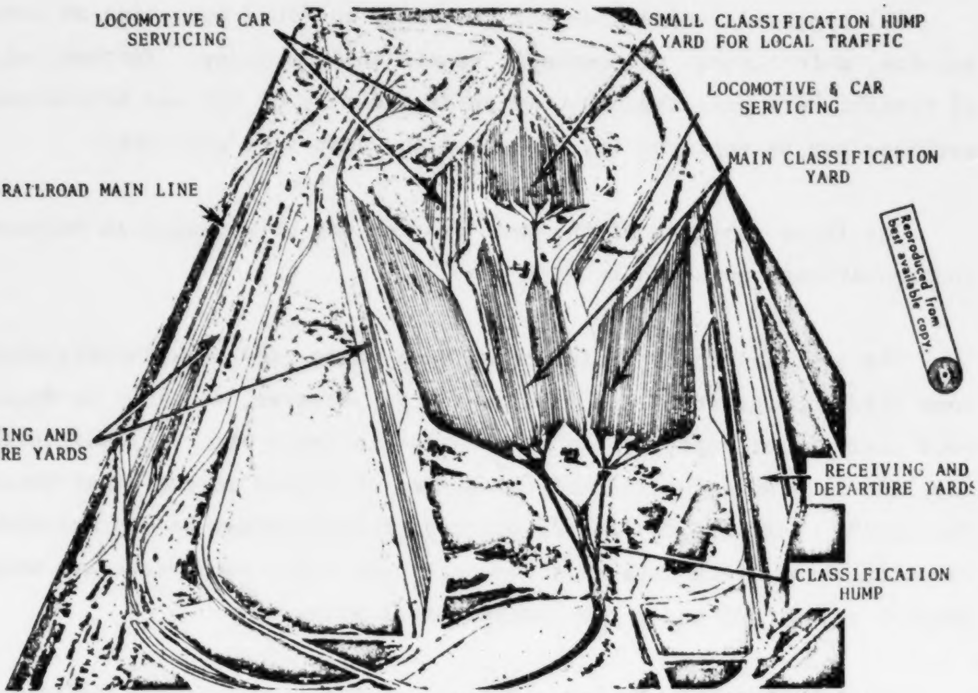
The three subyards of the yard complex may be arranged in various configurations, as shown in Figure 3-3.

The physical characteristics of hump yards vary considerably depending upon yard configuration and yard capacity. However, as shown in Figure 3-4, yard activity or capacity can be measured in terms of car classifications per day, and is also a function of the number of tracks in the classification "subyard". Further, the number of group retarders may be approximated from classification track data as shown in Figure 3-5. Hump yards are usually several miles long and a few thousand feet wide.

Each of the three "subyards" has a standing capacity of hundreds of cars resulting in a total standing capacity of thousands of freight cars. Hump yards may contain hundreds of miles of track within their boundaries and process dozens of trains and thousands of cars per day.

Some of the major characteristics of this type of railroad facility are summarized in Table 3-8. These data are based upon the two preceding figures and extractions from other reports.[4,5] Hump yard operational procedures may be found in Section 2.3 of Railroad Classification Yard Technology.[4]

Appendix O, Table O-1, contains a list of automated classification yards.[6] These data show that 79 of the approximately 124 hump yards in the U.S. railroad system are automated to some degree. Yard automation may include the receiving, service, classification and departure functions; car identification; switch control; speed control including car weight and rollability; and yard/car inventory and location. Examples of the new automated classification yards in the U.S. railroad system are Northtown (BN), Barstow (ATSF), West Colton (SP), Sheffield (SOU) and Bailey (UP).[7]


LOCOMOTIVE & CAR SERVICING
SMALL CLASSIFICATION HUMP YARD FOR LOCAL TRAFFIC
LOCOMOTIVE & CAR SERVICING
MAIN CLASSIFICATION YARD
RAILROAD MAIN LINE
RECEIVING AND DEPARTURE YARDS
RECEIVING AND DEPARTURE YARDS
CLASSIFICATION HUMP

Courtesy of Westinghouse Air Brake Co.

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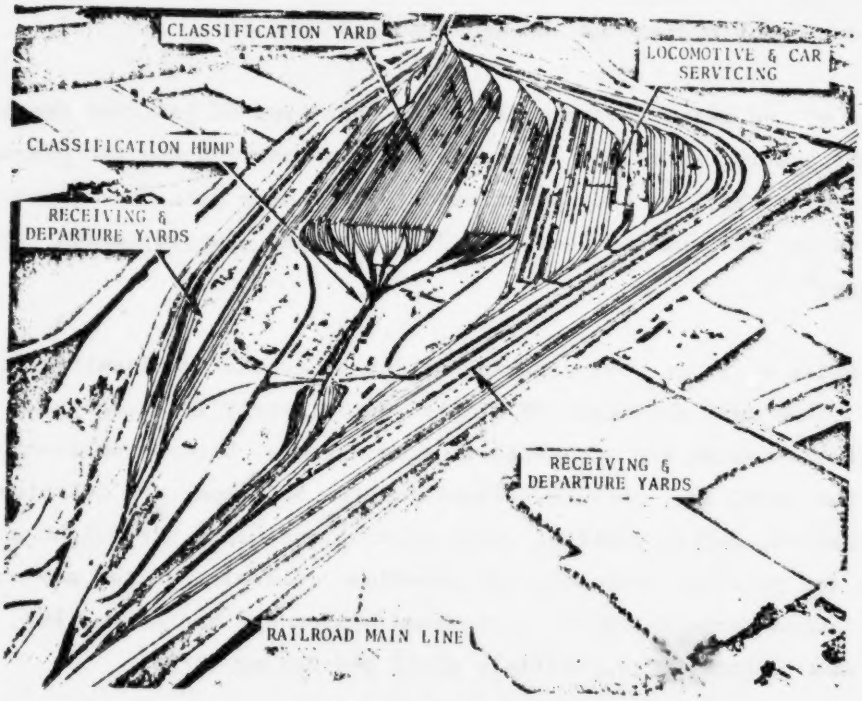

CLASSIFICATION YARD
LOCOMOTIVE & CAR SERVICING
CLASSIFICATION HUMP
RECEIVING & DEPARTURE YARDS
RECEIVING & DEPARTURE YARDS
RAILROAD MAIN LINE

Courtesy of Westinghouse Air Brake Co.

FIGURE 3-3. TYPICAL MODERN CLASSIFICATION HUMP YARD LAYOUTS

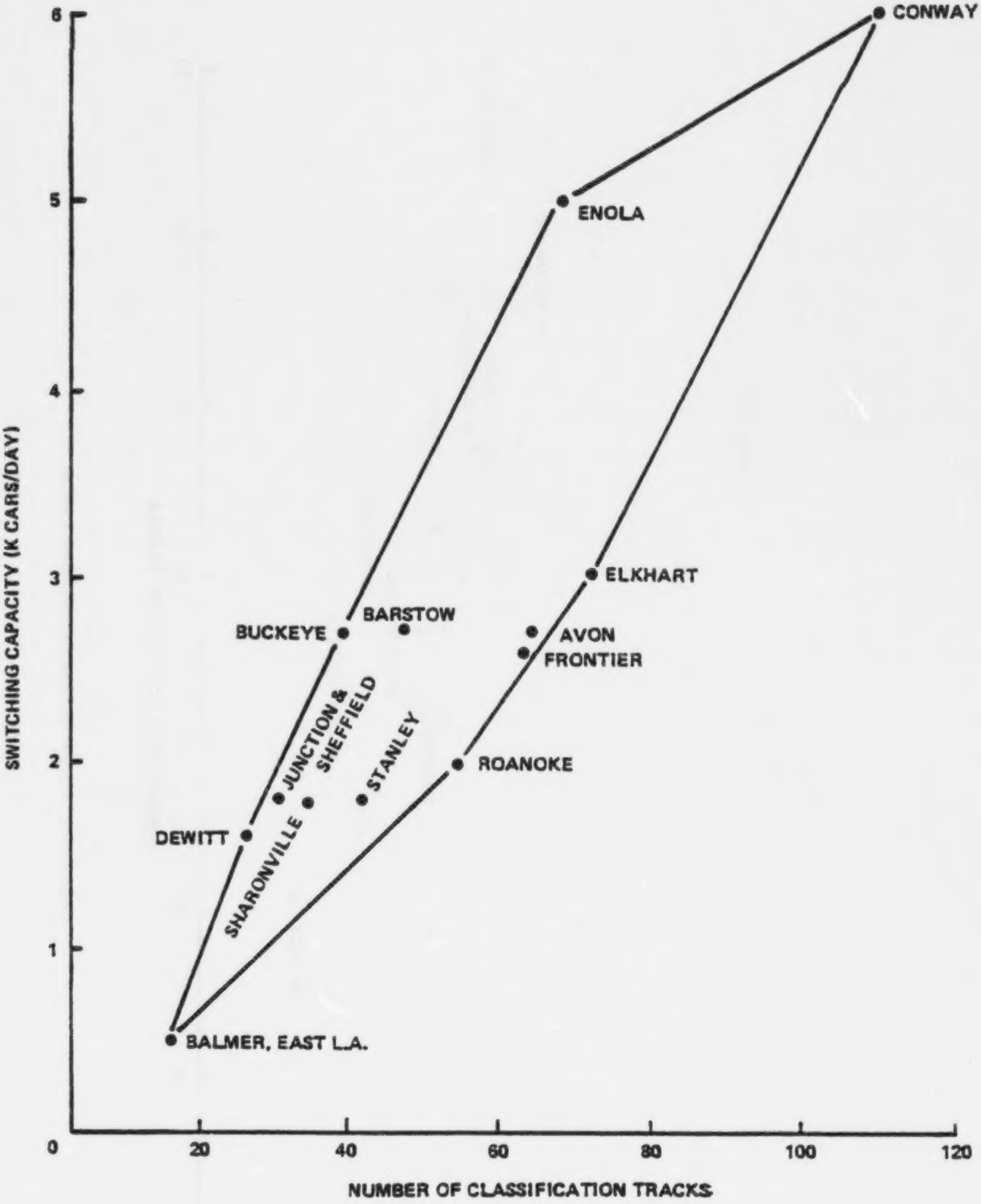


FIGURE 3—4. HUMP YARD CAPACITY

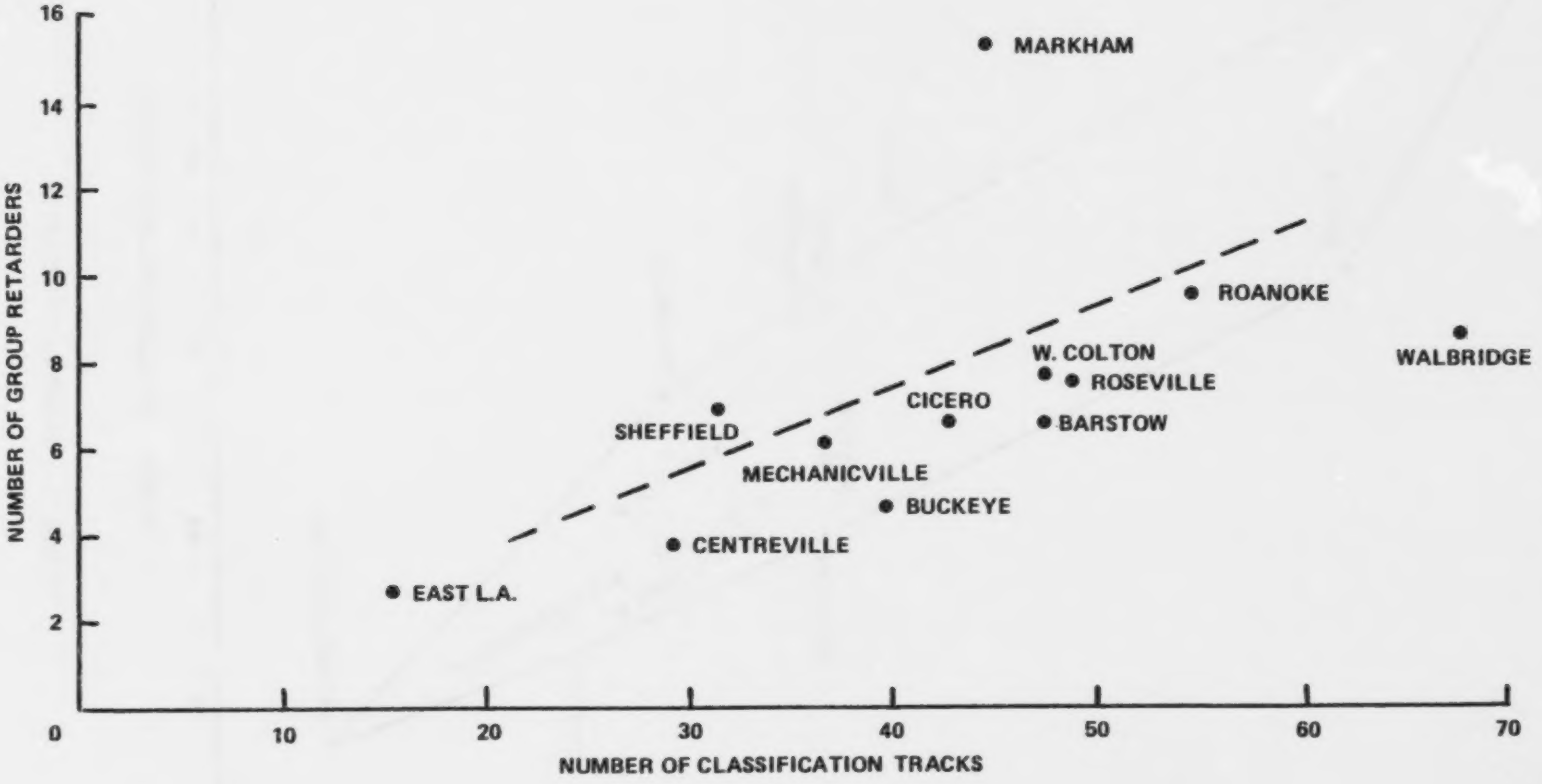


FIGURE 3–5. GROUP RETARDERS IN HUMP YARDS

Table 3-8

SUMMARY OF HUMP YARD DATA

	Yard Activity (Classified Cars Per Day)		
Yard Characteristic	<1000	1000 - 2000	>2000
Number of Classification Tracks	26	43	57
Number of Master Retarders	1	1	1
Number of Group Retarders	4	7	10
Number of Inert Retarders	26	43	57
Number of Receiving Yard Tracks	11	11	13
Number of Departure Yard Tracks	9	12	14
Standing Capacity of Classification Yard	1447	1519	2443
Standing Capacity of Receiving Yard	977	1111	1545
Standing Capacity of Departure Yard	862	969	1594
Number of Cars Classified/Day	783	1663	2661

Flat Yards

Flat yards also perform the classification and industrial service functions for the U.S. railroad system. This type of yard does not generally contain specific "subyards" for receiving, classification and departure but is generally configured as shown in Figure 3-6.[4]

Yard switcher locomotives move cars out of the receiving tracks and use either continuous push or acceleration/disconnect techniques to distribute them into specific classification tracks. The continuous push or the "bumping" action of the switcher locomotive accomplishes the same function in a flat yard as the "crest-roll-retard" action in a hump yard.

Flat yard tracks consist of switching leads, ladder tracks and receiving, classification and departure tracks. Flat yards may also contain "inert" retarders on some classification tracks, locomotive and car service/ repair facilities and other buildings associated with yard operations.

Flat yard activity or capacity, measured by cars classified per day, is a function of the number of tracks used for that function and available switcher locomotives. As shown in Figure 3-7,[5] this relationship is similar to that of hump yards.

Table 3-9 presents some typical data on flat yards showing yard characteristics similar to those shown for hump yards.[4]

SUMMARY OF RAILYARD STATISTICAL DATA

A recent survey of the railroad system in the U.S. has resulted in valuable data regarding the railyard inventory.[4] This section presents a condensation of that data and is designed to complement the data base used in other sections of this document.

The survey concludes that there are 4169 railroad yards in the contiguous 48 states. Of these, 124 are hump yards and 4045 are flat yards. Table 3-10

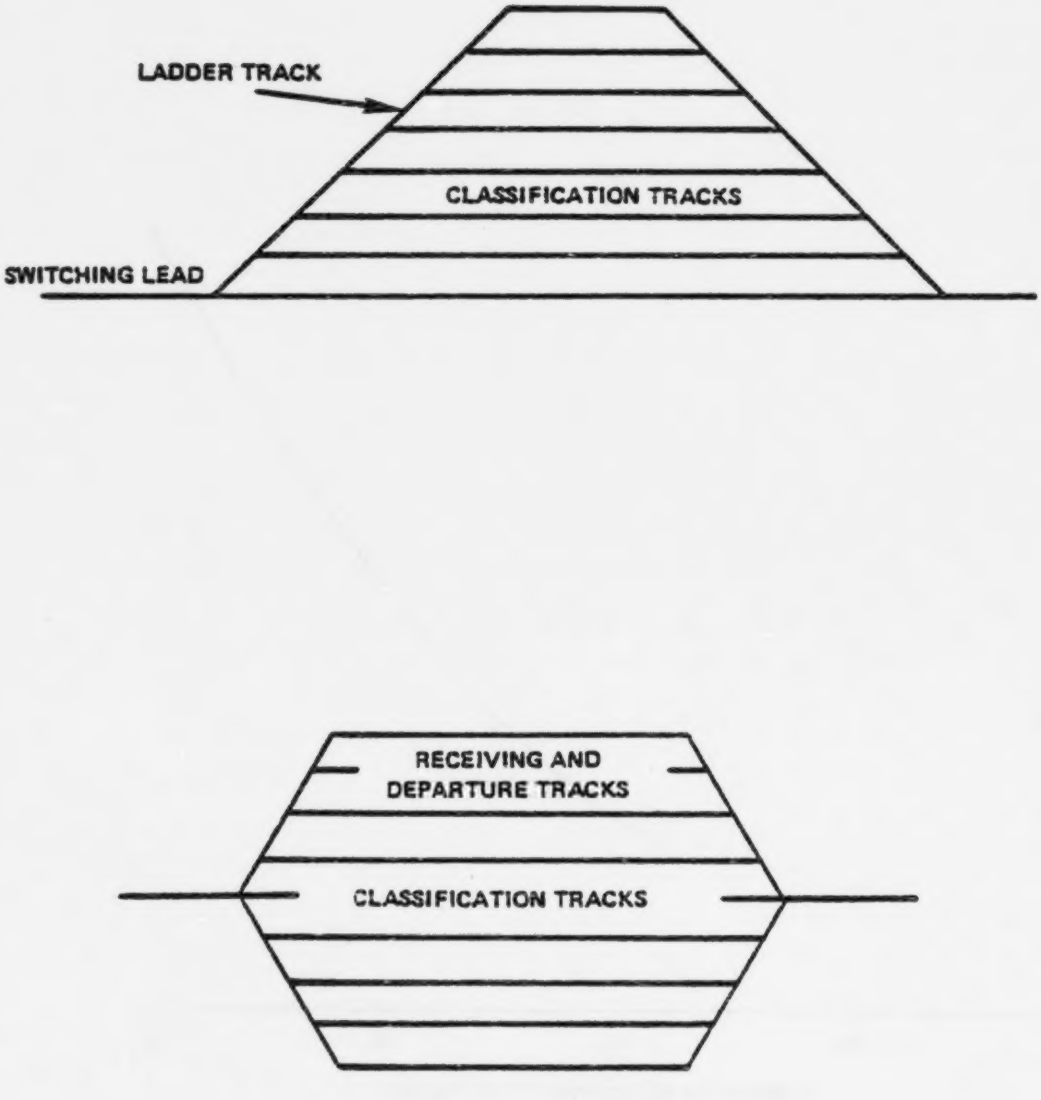


FIGURE 3–6. TYPICAL FLAT-YARD TRACK CONFIGURATIONS

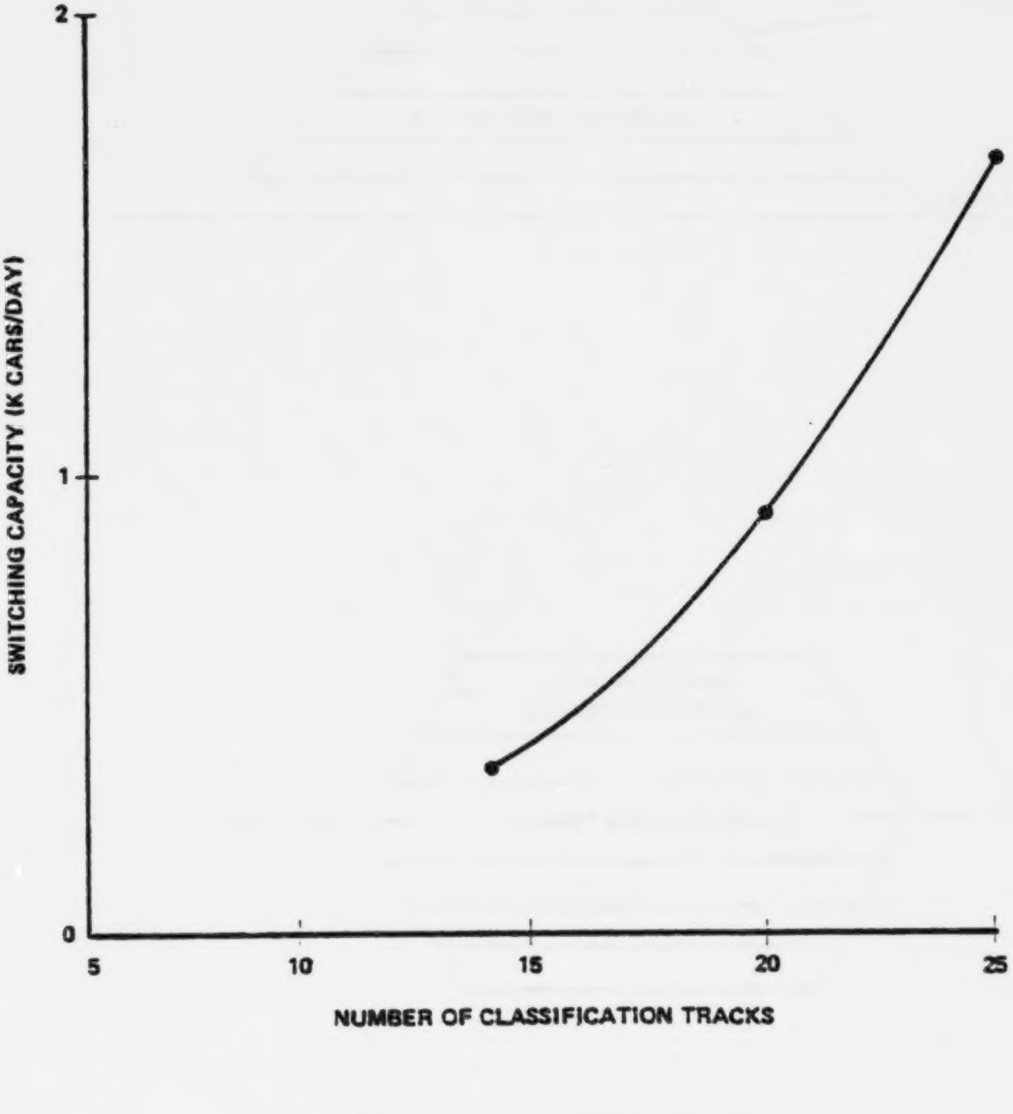


FIGURE 3–7. FLAT YARD CAPACITY

Table 3-9

SUMMARY OF FLAT YARD DATA

Yard Characteristic	Yard Activity (Classified Cars/day)		
	<500	500-1000	>1000
Number of classification tracks	14	20	25
Standing capacity of classification yard	653	983	1185
Cars classified/day	348	907	1692

Flat yard operational procedures may also be found in Section 2.3 of Railroad Classification Yard Technology.[4]

Table 3-10

DISTRIBUTION OF U.S. RAILROAD YARDS BY TYPE, FUNCTION, AND LOCATION

A. Number of Railyards

	Yard Function*			
Yard Type	C/I	C	I	Total
Hump	98	18	8	124
Flat	930	183	2932	4045
Total	1028	201	2940	4169

*C/I Commercial/Industrial
C Commercial
I Industrial

B. Percent of Yards for Judged Adjacent Land Use

	Predominant Adjacent Land Use **					
Yard Type	I	C	R	A	U	Total
Hump	20	7	27	13	33	100
Flat	21	11	35	12	21	100
Flat Ind.	30	16	32	4	18	100
Flat Small Ind.	31	14	28	8	19	100

**I Industrial
C Commercial
R Residential
A Agricultural
U Undeveloped

displays these yards by function and adjacent land use. These data show that the majority of yards perform the industrial service function and that only approximately five percent of the yards are used solely for car classification purposes. The data also indicate that only approximately 15 percent of the yards are judged to be in areas that are predominantly agricultural and undeveloped. The predominant land use data near the yards were based on subjective judgments by FRA personnel.

Table 3-11 shows the distribution of hump yards according to yard activity and population in the yard's locality. These data show that the highest concentration of hump yards is in areas of population size class 2 (5-50K persons) and in areas of industrial land use.

Table 3-12 shows the distribution of the 1113 flat yards used for the car classification function. These data also show that population size two and industrial areas have the highest concentration of this yard type. Table 3-13 shows the distribution by locality population class.

Since the railyard noise impact model that is developed in Section 5 uses 3 place size (locality population) classes, 3 traffic rate classes and 4 functional yard types, a summary of the yard data presented in Table 3-14 is shown in terms of number of yards by type of yard, place size of yard location and rate of traffic (activity). (The numbers of yards in the six place sizes in Tables 3-11 and 3-12 were transferred to the distribution of yards by 3 place sizes in Table 3-14.)

RAILYARD CONFIGURATION ANALYSES

Introduction

Preliminary analyses indicated considerable variation in the configuration of railyard facilities. Thus, accurate analyses of railyard noise impact and noise reduction costs required determination of typical or representative yards in terms of yard geometries and dimensions as well as noise source locations relative to yard boundaries and adjacent residential areas. The

Table 3-11

NUMBERS OF HUMP YARDS BY ACTIVITY
AND POPULATION OF LOCALITY

Yard Activity	Population of Locality 1 0-5K	2 5-50K	3 50-100K	4 100-250K	5 250-500K	6 >500K	Total Yards
Low	8	11	7	8	5	8	47
Medimum	1	18	3	8	6	10	46
High	4	10	2	6	5	4	31
Total	13	39	12	22	16	22	124

Table 3-12

NUMBERS OF FLAT YARDS BY ACTIVITY
AND POPULATION OF LOCALITY

Yard Activity	Population of Locality 1 0-5K	2 5-50K	3 50-100K	4 100-250K	5 250-500K	6 >500K	Total Yards
Low	102	219	75	60	42	73	571
Medimum	64	140	48	35	23	47	357
High	33	71	23	21	12	25	185
Total	199	430	146	116	77	145	1113

Table 3-13

DISTRIBUTION OF ALL YARDS BY LOCALITY POPULATION

Population of Railroad Locality	Yards	
	Number	Percentage
0 - 5000	1128	27
5K - 50K	1664	40
50K - 100K	378	9
100K - 250K	290	7
250K - 500K	254	6
>500K	455	11
Total	4169	100%

Table 3-14

RAILYARD DISTRIBUTION BY YARD TYPE, PLACE SIZE AND TRAFFIC RATE CATEGORY

NUMBER OF RAILYARDS

Place Size (Population)

Yard Type	Less Than 50,000 Traffic Rate: Low	Med	High	50,000 to 250,000 Traffic Rate: Low	Med	High	Greater Than 250,000 Traffic Rate: Low	Med	High	Total
I Hump Classification	19	19	14	14	12	8	13	16	9	124
II Flat Classification	321	204	104	135	83	44	115	70	37	1113
III Industrial	849			239			293			1381
IV Small Industrial		1262			133			156		1551
Total		2792			668			709		4169

available maps, which consisted mainly of U.S.G.S 7.5 minute quadrangle maps, did not provide sufficient detail to detect yard boundaries and noise source locations. This type of information was essential to developing the input parameters (source to boundary distances, land use distributions, etc.) for the noise propagation models, the health and welfare impact model and the noise reduction cost model. Therefore, the assistance of the EPA's Environmental Photographic Interpretation Center (EPIC) was enlisted to provide additional data through examination of aerial (photographic) imagery of railyard complexes. The objective of the photographic evaluation was to acquire sufficient data (yard boundary dimensions, etc.) to develop, within acceptable statistical certainty limits, representative configurations for each type of yard.

The data sought from the EPIC study included:

- Percentage distribution of land uses (agricultural, commercial, industrial, residential and undeveloped) along the railyard boundaries, and within a one-half mile wide strip along both sides of the railyards.
- Boundary to boundary and track to track widths of the receiving, departure and railcar classification areas of railyard complexes
- Lengths of receiving, departure and classification areas.
- Distances from railyard boundaries to the nearest cluster of residences, measured from several locations around the yards.
- Distances to yard boundaries on each side from master retarders and repair facilities and distances from yard boundaries to locations where road-haul locomotives and switch engines are parked or operating.

The selection of the railyard sample from which the representative yard data were obtained was conducted by a random process to avoid inadvertent biasing of the desired input parameters for the health and welfare impact model. The 4169 rail classification yards were grouped according to 4 yard types, and distributed by 3 place size classes. Due to schedule and resource constraints, sampling consisted of only ten yards for each of the twelve yard type-place size combinations (i.e., cells), for a total of 120 representative yards. The sample size of 10 yards in each cell was selected on the basis of using the statistical t-distribution for evaluating the expected standard deviation limits about the sample mean dimension values for various confidence limits. Since the t-distribution analysis is relatively insensitive to the total population size, the sample size of 10 is satisfactory for the range 40 to 1000 yards of each type. Details of the selection procedure and results are given in Appendix K.

Using the initial list of 120 rail yards, EPIC located each yard on U.S. Geological Survey (U.S.G.S.) quadrangle maps, samples of which are shown in Appendix K, Figures K-1 and K-2. EPIC then ascertained whether there was sufficient recent aerial imagery of the yard and vicinity to gather the necessary data. There were 25 yards which either had been abandoned or for which there was inadequate photo imagery available. In these cases, another yard was selected from the appropriate cell on the substitution yard list.

Bausch and Lomb zoom scopes and light table for viewing transparencies (transparent aerial imagery) of the yard areas were used for photo analyses and to produce overlays (see Appendix K, Figures K-3 and K-4) on the U.S.G.S. quandrangle maps indicating yard boundaries and land areas within 2000 feet (610 m) of the boundaries. Based on the Standard Land Use Coding System (re. U.S. DOT-FHWA 1969), the land uses around each yard were grouped into residential, commercial, industrial, agricultural and undeveloped land use types. In addition to determining yard boundaries and land use areas, EPIC extracted the following yard data from the aerial imagery using a scaled eye loop on tube magnifier in some cases: distance from boundaries to residential areas; yard dimensions; and location of identifiable noise sources within the yard. The latter sources included repair facilities, retarders, switch engines, road engines, trailer-on-flat car/container-on-flat car (TOFC/COFC and bulk loading facilities. Figure K-5 and K-6 illustrate the data sheets used, with data from two sample yards.

Data Evaluation

The random selection of railyards in the hump and flat classification types was conducted independently of considerations regarding the activity parameters of the yards, since the traffic rate category of any particular yard was unknown. However, the detail of analyses necessary for the health and welfare and cost impact models required determination of typical railyard dimensions for the low, medium and high activity or traffic rate categories. Therefore, it was necessary to estimate from the sample yard dimensions into which category each railyard could be placed. The procedure for doing this is discussed in Appendix K.

The purpose of classifying the sample hump and flat classification yards into low, medium and high activity rates was to provide groups of sample yards for which the dimensions could be tabulated and averaged to derive representative yard configurations of each type. This was done irrespective of the place size class for each sample yard location since there was no indication that yard dimensions were correlated with place size (or location). For example, the representative dimensions for low traffic rate hump classification railyards were obtained by averaging the dimensions from 3 sample hump yards located in the small place class, 3 in the medium place size class and 3 in the large place size class.

Examination of the data for the flat and hump classification yards indicated that, in general, the yards were asymmetrical and quite complicated in configuration. Time constraints and data limitations required that the yard data be reduced to obtain simplified representative yard configurations. Therefore, it was assumed that the various portions of the railyards were rectangular and that groups of noise sources were located within the rectangular areas at unequal distances from the yard boundaries. In addition, the yard configuration and noise source location analyses indicated that the master retarder, engine repair and idling road haul locomotive locations were in the same general area. Therefore, the dimensions obtained from the EPIC analyses were grouped into distances from the sources (or assumed source group locations) to the nearest and farthest yard boundaries. In the case of the observed locomotives, at any yard, the weighted average distances to the boundaries were obtained by multiplying the number of locomotives by the corresponding distances, summing the products and then dividing by the number of locomotives observed. Thus, the measured dimensions for each group of yards (low, medium and high traffic activity groups determined as discussed previously) were tabulated and then averaged. The resulting average dimensions are shown in Tables 3-15 through 3-17.

Also, the hump yard classification area widths were averaged with the master retarder, engine repair facility and road haul locomotive distances to obtain the representative average distances (D_{avg}) to the near and far boundaries. In the case of the flat classification yards, the classification area widths were averaged with the source to boundary distances for the observed engine repair facilities, road locomotives and switch engines. The observed engine repair facilities and road haul locomotives were assumed to indicate that the positions of the load test facilities and storage of idling locomotives (identified noise sources for the noise impact model) were at the master retarder end of the classification area.

In the case of flat classification yards, the locations of the switch engines observed by EPIC were not specified, however, they were assumed to be located at each end of the classification area, and thus tended to also indicate the dimensions of the classification area. Similar analyses of the data from the sample industrial and small industrial yards resulted in the representative dimensions shown in Table 3-17. The configurations of the industrial and small industrial yards were generally more symmetrical than the other yards, and thus, the representative dimensions indicate that sources were located in the center of the yard areas (equi-distant from the boundaries on either side).

Representative Rail Yard Configurations

The representative configurations derived from the EPIC railyard data evaluation are shown in Figures 3-8 and 3-9. The hump and flat classification yards were assumed to have identical receiving and departure area dimensions

Table 3-15

SUMMARY OF AVERAGE DIMENSIONS FOR HUMP CLASSIFICATION YARDS

Hump Yards	Average Dimensions (m) Traffic Rate: Low		Medium		High	
	Near**	Far**	Near	Far	Near	Far
Classification Area:						
D_w^*	63	193	84	170	107	210
D_{MR}	60	235	100	191	112	224
D_{ER}	68	129	90	224	113	299
D_{RL}	69	177	99	214	116	188
D_{AVG}	64	183	95	201	113	229
L		1129		1312		1739
Receiving and Departure Area:						
$D_{avg}=D_w$	46	137	40	146	55	171
L		1556		1952		1952

*D_w Near = Track to track width ÷ 2
D_w Far = Boundary to boundary width ÷ 2
D_{MR} = Distance from master retarder to yard boundary
D_{ER} = Distance from engine repair area to yard boundary
D_{RL} = Weighted average distance from road haul locomotives to yard boundary
**Shorter and larger distances from source to boundaries.

Table 3-16

SUMMARY OF AVERAGE DIMENSIONS FOR FLAT CLASSIFICATION YARDS

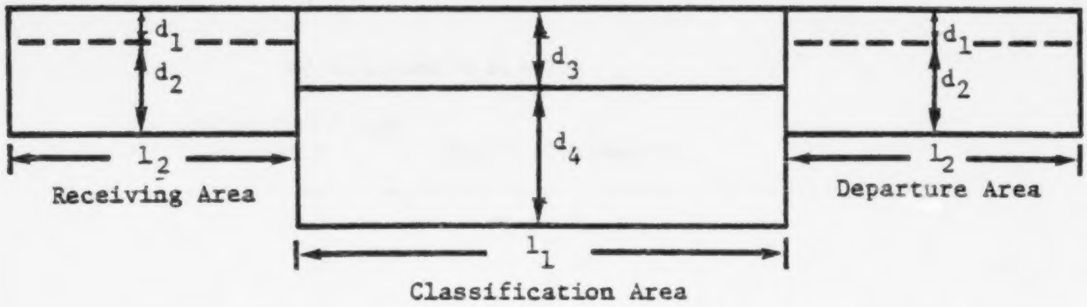
Flat Classification Yards	Average Dimensions (m) Traffic Rate:					
	Low		Medium		High	
	Near**	Far**	Near	Far	Near	Far
Classification Area:						
D_W^*	24	73	40	-	70	183
D_{ER}	40	104	-	-	-	159
D_{RL}	***	-	24	116	119	-
D_{SE}	46	143	-	140	104	293
D_{AVG}	37	107	32	128	92	214
L		854		1311		2074
Receiving and Departure Area:						
$D_{avg}=D_w$	31	107	31	137	92	184
L		793		976		1250

*D_w Near = Track to track width $\div$ 2
D_w Far = Boundary to boundary width $\div$ 2
D_{ER} = Distance from engine repair area to yard boundary
D_{RL} = Weighted average distance from road haul locomotives to yard boundary
D_{SE} = Weighted average distance from switch engines to yard boundary.
**Shorter and larger distances from source to boundaries.
***Blank space indicates uncertainties in data. Averages judged not applicable.

Table 3-17

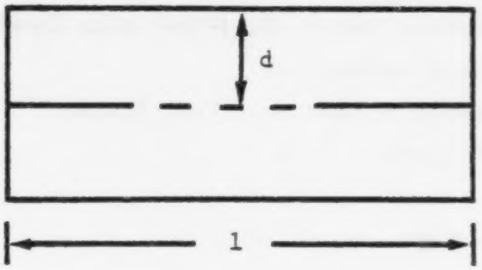
REPRESENTATIVE AVERAGE DIMENSIONS FOR INDUSTRIAL AND SMALL INDUSTRIAL RAILYARDS

	Average Dimensions (m)	
	Industrial Yards	Small Industrial Yards
D_W	70	52
D_{RL}	58	24
D_S	62	31
D_{AVG}	70	52
L	1312	1007



Yard Type		Representative Railyard Dimension (m)					
I.	Hump Classification:	d_1	d_2	d_3	d_4	l_1	l_2
	Traffic Rate:						
	Low	43	137	64	192	1556	1129
	Medium	43	146	95	192	1952	1312
	High	55	171	113	229	1952	1739
II.	Flat Classification:						
	Traffic Rate:						
	Low	31	107	34	107	793	854
	Medium	31	137	34	128	976	1312
	High	92	183	92	214	1251	2074

FIGURE 3-8 REPRESENTATIVE CONFIGURATION FOR HUMP AND FLAT CLASSIFICATION RAILYARDS



Yard Type	Representative Dimensions (m)	
	d	l
Industrial	70	1312
Small Industrial	52	1007

FIGURE 3-9 REPRESENTATIVE CONFIGURATION FOR FLAT INDUSTRIAL AND SMALL INDUSTRIAL RAILYARDS

- FLAT CLASSIFICATION YARD - NOISE SOURCES:
  - CSE - Classification Switchers, East End of Yard
  - CSW - Classification Switchers, West End of Yard
  - CI - Car Impacts
  - IB - Inbound Trains
  - OB - Outbound Trains (Road-Haul plus Local)
  - IL - Idling Locomotives
  - LT - Locomotive Load Cell Test Stands
  - RC - Refrigerator Cars
- FLAT INDUSTRIAL YARD - NOISE SOURCES:
  - SE - Switch Engines
  - CI - Car Impacts
  - IB - Inbound Trains
  - OB - Outbound Trains (Road-Haul plus Local)
- SMALL INDUSTRIAL FLAT YARD - NOISE SOURCES:
  - SE - Switch Engines
  - CI - Car Impacts
  - IB - Inbound Trains
  - OB - Outbound Trains

The yard noise sources identified but not modeled include horns and whistles, locomotive brake squeal, wheel-track screech on curves, loudspeakers, slack pull-out (between cars in outbound trains or cuts of cars), compressed air release from car air brake-bleed and pneumatically operated switches and retarder mechanisms and other unidentified yard equipment. However, the indications from the data base are that, although the non-inclusion of these sources (which may be present in some yards, and types of yards, but not in others) results in a degree of uncertainty in the determination of the overall noise levels at railyard boundaries, the major noise sources identified in the preceding yard noise source list produce noise (the receiving and departure areas were not distinctive and could usually not be differentiated on the photographic imagery). The d_1 distance of 43 m for the low and medium traffic rate hump yards is the average of the corresponding distances of 40 and 46 < m previously determined. Also, the d_4 distance of 192 m for the low and medium traffic rate is the average of the corresponding far side distances of 183 and 201 m previously determined. Similar averaging was done to obtain the d_3 distance of 34 m for the low and medium traffic rate flat classification yards.

Railyard Noise Sources

Prior to and in conjunction with the EPIC sample railyard analyses the predominant noise sources for each class of railyard were identified by examining the literature and data base on railroad equipment and facility surveys. Discussions with the AAR staff and consultants provided additional data on potential noise sources. The identified noise sources for which a sufficient noise data base were available to determine a statistically meaningful average level were included in the railyard noise model. The major noise sources included in the railyard noise model and health/welfare impact model are listed below according to yard type and function category:

- HUMP YARD - NOISE SOURCES:
    - MR - Master Retarders (Includes Group, Intermediate, and Track)
    - HS - Hump Lead Switchers
    - IR - Inert Retarders
    - MS - Makeup Switchers
    - CI - Car Impacts
    - IL - Idling Locomotives
    - LT - Locomotive Load Tests
    - RC - Refrigerator Cars
    - IS - Industrial and Other Switchers
    - OB - Outbound Trains (Road-Haul plus Local)
    - IB - Inbound Trains

levels and event rates sufficiently high to provide good indicators for the noise environment and impact at the railyard boundaries. Load test facilities were assumed to be located at high level activity hump and flat classification yards only. This assumption was based on survey data provided by the AAR.

Although the exact location of sources in various portions of yard complexes are unknown for industrial yards, there are some indications of general source locations. Information derived from the EPIC railyard survey, the AAR and consultants regarding railyard operations was used to develop reasonable source placements within the yard complexes. For example, it was assumed that locomotive load test stations and storage of idling locomotives would be positioned in the general area of engine repair facilities. During the EPIC railyard survey it was observed that engine repair facilities (and load test cells) were frequently situated near the master retarder end of the classification yard. It seemed logical to consider switch engine and inbound train operations located in the receiving yard, and other switch engine and outbound train operations located in the departure yard. (See Figure 3-8)

The hump and flat classification railyards were thus assumed to have four (4) general noise source areas. In the absence of any specific data on yard activity parameters, it was assumed that the distances moved by switch engines and inbound and outbound locomotives are equal to the receiving and departure yard lengths of the hump and flat classification yards, and to the yard lengths of the other industrial and small industrial yard types. (See Figures 3-8 and 3-9)

Land Use Distribution Analyses

The percentage distribution of residential commercial, industrial, agricultural and undeveloped land uses was calculated from the EPIC overlays and U.S.G.S. maps (See Figures K-1 through K-4). EPIC had delineated yard boundaries as well as land use (per Standard Land Use Coding System) within 2000 ft (610 m) from yard boundary.

The percentage land use distribution adjacent to each yard was calculated by using linear distances intercepted along the yard boundary. These values were then averaged for ten yards in each of the twelve cell-groups by place size and yard type, as presented in Table K-5.

The percentage land use distribution within 2000 ft (610 m) from each yard boundary was calculated by separately adding the areas of each of the five land uses. These values were averaged for ten yards in each of the twelve cell-groups by place size and yard type, as presented in Table K-6.

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1. Letter from Philip F. Welsh, Association of American Railroads to Henry E. Thomas, U.S. Environmental Protection Agency, November 8, 1977.

2. Final System Plan, Supplemental Report, U.S. Railway Association, September 1975.

3. The Official Railroad Equipment Register, Vol. 93, No. 2, National Railway Publication Co., New York, N.Y., October 1977.

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6. Automatic Classification Yards - United States and Canada, Association of American Railroads, Washington, D.C., May 4, 1977.

7. Railway Age, Vol. 179, No. 6, Simmons-Boardman Publishing Corp., Bristol, Conn., March 27, 1978.

SECTION 4

NOISE SOURCE EMISSIONS AND NOISE CONTROL TECHNOLOGY

RAILROAD NOISE SOURCES

Noise is generated by rail carriers during the operation of nearly all the equipment listed in Section 3. In order to characterize railroad noise emissions, the EPA has attempted to determine noise levels both from individual sources and from the operation of multiple sources which are combined into larger single operations such as a classification yard. The understanding of how multiple sources interact to produce an overall noise level is essential since it is the combined noise of several sources which is generally heard outside the boundaries of railroad facilities. A knowledge of individual equipment noise source levels is equally important since individual noise source treatment is usually the most effective method for reducing overall noise emissions. The individual sources which have been identified as major contributors to railroad noise are:

- Locomotives and switch engines
- Retarders
- Refrigerator cars
- Car-coupling
- Load cells, repair facilities and locomotive service areas
- Wheel/Rail interaction
- Horns, bells, whistles and public address systems

The primary focus in this background document is on the above railyard noise sources. Other railroad operations such as stations and offyard repair facilities are minor contributors to community noise when compared to wayside noise from line operations and noise emissions from yard operations. Noise from line operations has been covered in a previous EPA background document[1], and will be reviewed only briefly in this document.

RAILROAD PROPERTY NOISE SURVEY PROGRAM

The EPA has undertaken a noise measurement program to determine the extent of noise emissions around railyards. This program was limited by the time available. The measurements taken in this effort supplement the existing railroad noise data base and provide baseline data at and near railyard property lines.

This program included twenty-four hour measurements at each facility to ensure that the measured noise emissions were characteristic of the facility. Sound equivalent levels and statistical percentile levels were computed hourly. Noise correlate data, such as individual noise events and distances to railroad yard noise sources, were also noted during the recording period. These data, together with existing data collected previously by the EPA serve the following purposes:

- Establish the relationship of these measurements to selected railyard type, yard function, and level of activity, as a basis for the development of classification categories;
- Establish a baseline for determining the benefits afforded to the health/welfare of the nation's population by reducing noise emissions within each property classification category; and
- Select a measurement methodology, which is consistent with the health/welfare analysis and the noise emission data base, for prescribing "not-to-exceed" noise emission level standards.

MEASUREMENT METHODOLOGY

In developing a noise emission test procedure, EPA recognized the need for a relatively simple method of accurately determining noise emissions which would be suitable for enforcement auditing by the Federal Railroad Administration of the Department of Transportation and compliance determination by the railroads and state and local enforcement officials. A methodology was chosen consistent with this objective that it should:

- Ensure that the noise emissions characteristic of major noise sources are repeated and accurately represented;
- Correlate well with the known effects of environmental noise upon public health and welfare;
- Discriminate between railroad and non-railroad noise sources; and
- Enable convenient measurement at noise sensitive locations.

The procedures developed estimate average maximum A-weighted sound levels at receiving property measurement positions for each of the noise sources considered. Additionally, measurement procedures at fixed locations from certain nearly steady state sources are also prescribed. The measurement procedures appear in Appendix A.

EXISTING NOISE DATA BASE

The data base for railroad noise exists in two forms. The first addresses specific railroad noise sources. These data are contained in several documents and reports.[1,2,3,4,5,6,7] The other form focuses on overall railyard noise levels resulting from the combined railyard noise sources and will be published as part of a separate document to be published in approximately one year from the publication of this document.

Table 4-1 summarizes the data base for source noise levels with the principal contributors to railroad yard noise represented. These data are energy averages of the data points available for each noise source. Additional information on the data base and the computational procedures used to calculate baseline levels appear in Appendix L. Figures 4-1 through 4-3 show typical noise spectra for five prominent railyard noise sources.

Table 4-1

SOURCE NOISE LEVEL SUMMARY

Noise Source	Number of Measurements	Level of Energy Average* L_{Ave} @30 m (dB)**
Retarders (Master and Group)	410	111
Inert Retarder	96	93
Flat Yard Switch Engine Accelerating	30	83
Hump Switch Engine, Constant Speed	Reference 2	78
Idling Locomotive	82	66
Car Impact	164	99
Refrigerator Car	23	67
Load Test (Throttle 8)	59	90

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* L_{Max} Average for Intermittent or Moving Sources

** A-Weighted Sound Level

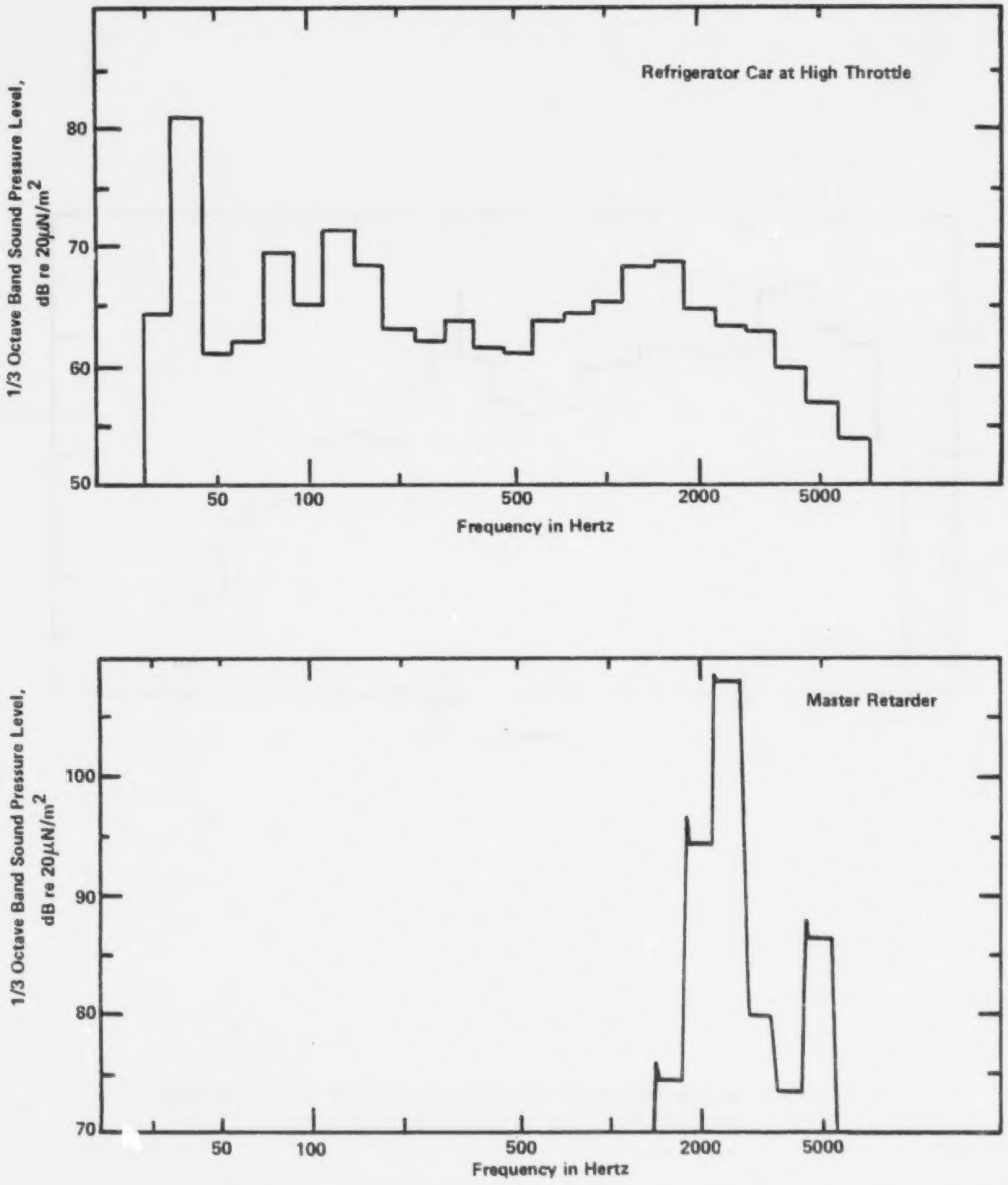


FIGURE 4-1 FREQUENCY SPECTRUM OF NOISE EMITTED FROM MASTER RETARDER at 100 ft (30 m) AND MECHANICAL REFRIGERATOR CAR at 50 ft (15 m)

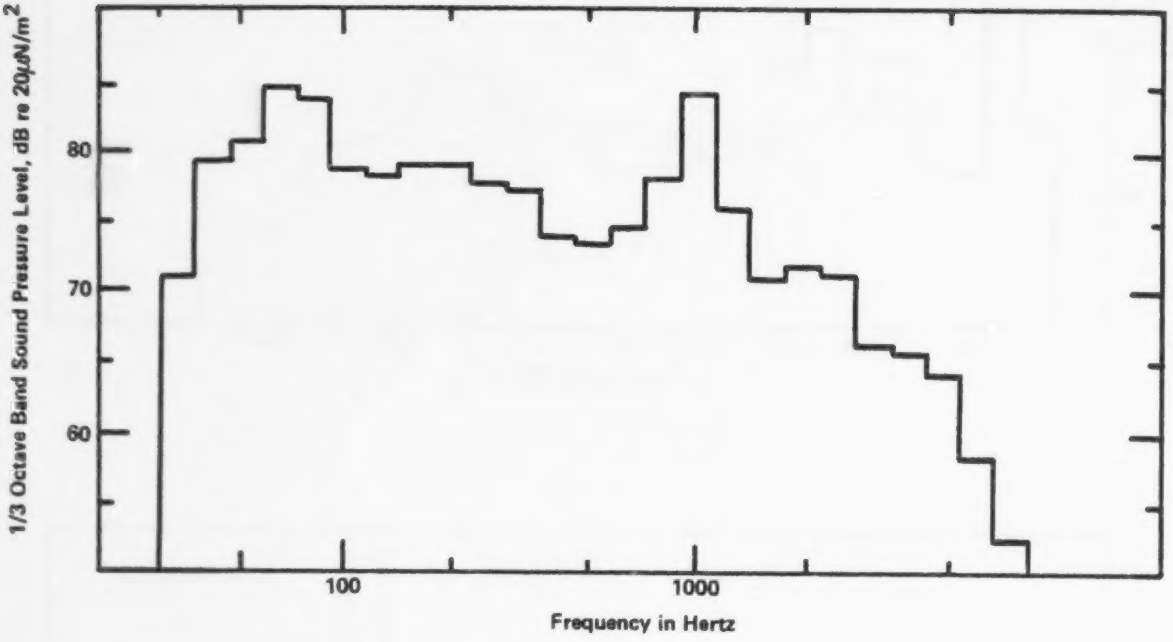


FIGURE 4-2 NOISE FREQUENCY SPECTRUM OF CAR COUPLING IMPACT--MEASUREMENTS 100 FEET (30 m) FROM TRACK

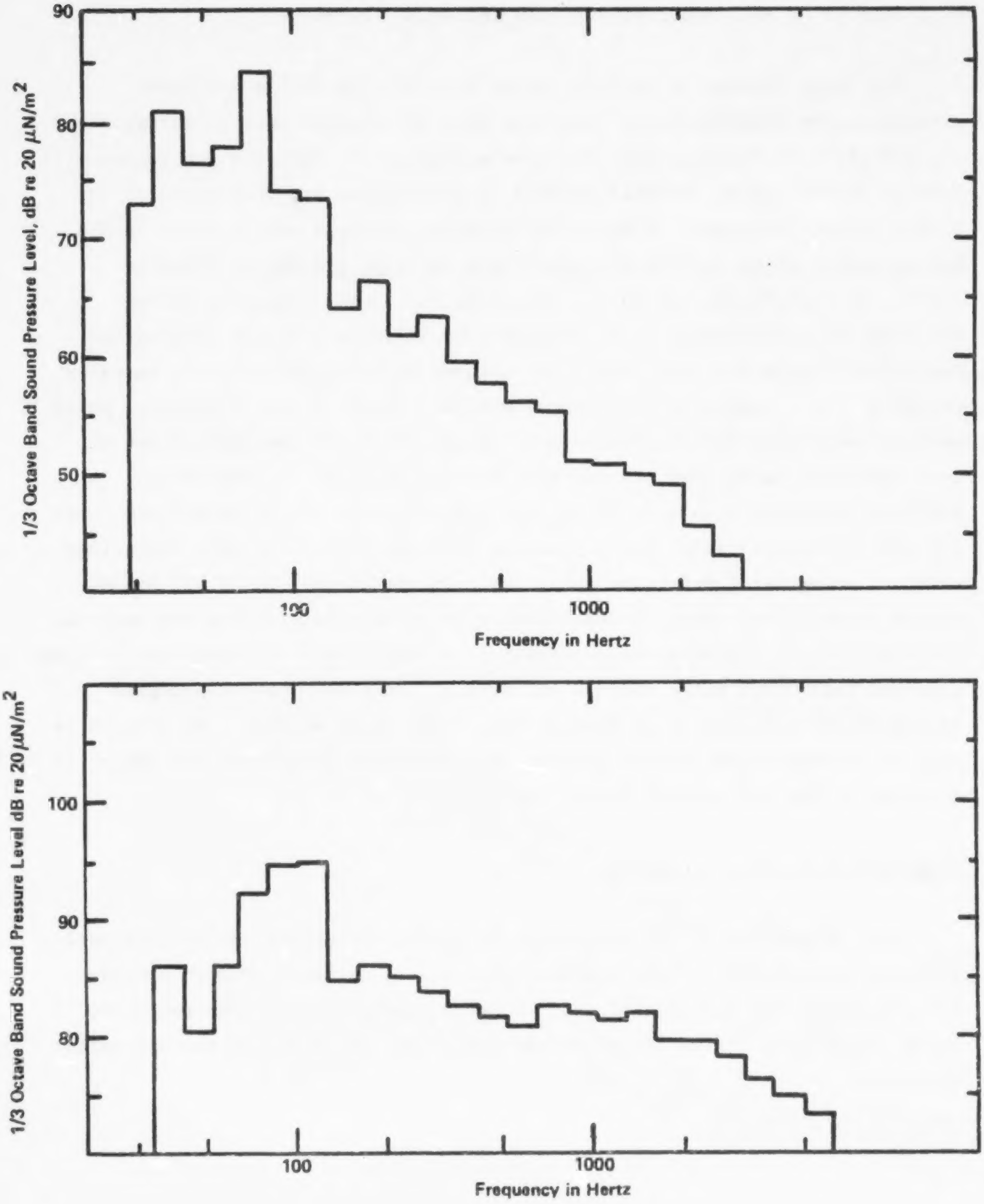


FIGURE 4-3 NOISE FREQUENCY SPECTRA OF IDLING SWITCHER AND LOCOMOTIVE AT THROTTLE SETTING NO. 8 --MEASUREMENT AT 50 FEET (15 m)

DESCRIPTIONS OF YARD NOISE SOURCES AND ABATEMENT TECHNOLOGY

The major sources of railroad noise and the alternative abatement procedures for reducing noise emissions from the sources were investigated by the EPA prior to issuing noise emission standards for railcars and locomotives in January 1976. A brief summary of the sources and treatments is included in this document. A more comprehensive analysis can be found in EPA Background Document for the Railroad Noise Emission Standards, December 1975[1]. In considering the noise control technology available to reduce railroad noise emissions, it is necessary to consider also the alternative regulatory approaches which might be employed in developing a noise emission standard. For example, a source-type standard requires that individual noise sources meet specified "not-to-exceed" levels which are generally based on best available technology, taking into account the cost of compliance. For a property line-type standard, individual noise sources do not have fixed "not-to-exceed" levels. Thus, for a property line standard, available technology requires only that total noise emissions from the operations of all equipment on the property not exceed a specified level at each point along the railroad property line or the adjacent receiving property. The discussion that follows examines individual noise sources and some of the abatement technologies available for reducing noise impacts from these noise sources. No attempt is made to determine the overall average railyard noise levels and the reduction achievable from all sources collectively.

Locomotives and Switch Engines

Over 99 percent of the trains in the United States are hauled by diesel-electric locomotives. A few trains, particularly in the Northeast corridor, are powered by all-electric or gas turbine locomotives. The few remaining steam locomotives in the United States are preserved primarily for historical reasons.

Diesel-electric locomotives have a diesel engine driving an electric alternator or generator which, in turn, powers electric traction motors on the wheels. The electrical system acts as an "automatic transmission" and, in a given throttle setting, maintains a constant load on the engine for differing train speeds. The operation of diesel-electric locomotives represents a major source of the noise emitted from yards. The important noise-producing mechanisms in diesel-electric locomotives are engine exhaust, engine casing vibrations and cooling fans.

Noise abatement treatment for locomotives and switch engines detailed in the 1975 EPA Railroad Backround Document[1] can be summarized as follows:

- Equipment modification
  - Improved exhaust muffling
  - Cooling fan modification
  - Engine shielding

- Operational procedures
  - Park idling locomotives closer to center of the yard or away from residences
  - Reduce speed
  - Reduce nighttime operations.

Retarders

Within the classification portion of most major U.S. hump yards, track mounted breaking devices known as retarders are used to control the velocity of free-rolling freight cars. The speed with which the cars enter the classification track must be controlled, so that the momentum upon impact is just sufficient to ensure coupling. The master retarder at the entrance to the switching zone provides velocity control and spacing between the cars, while the group retarders at the entrance to each group of classification tracks bring the cars to the speed required for final coupling.

Retarders are mechanical devices which clamp a beam or beams against the wheel flanges of the cars, thereby creating a friction force which slows the forward motion of the cars. The amount of retardation is controlled by varying the pressure applied to the beam. The friction force, in addition to slowing the railcar, can produce and radiate an intense squealing noise.

Three approaches for reducing the noise emissions from retarder squeal have been developed and are currently in use in some hump yards. They are:

- Barriers
- Lubrication systems
- Ductile iron shoes.

Barriers have proven effective at the Madison Yard, operated by the Terminal Railroad Association of St. Louis. These barriers are twelve feet high, measured from the top of the rail, with the peak of the barriers located approximately eight feet (2.4 m) on a perpendicular line to the rail track center. The barrier's construction consists of supporting timbers, corrugated transite, and four inch (10 cm) fiberglass absorptive material with protective covering. Noise measurements before and after barrier installation showed that the noise levels were reduced up to 25 dB.

Similar noise measurements conducted as part of a Department of Transportation study[8] on railroad retarder noise reduction at the Burlington Northern Railroad, Northern freight yard, showed typical insertion loss values at 100 ft (30 m) from the retarder in a direction perpendicular to the barrier were 16 dB to 22 dB for absorptive barriers. Figures 4-4, 4-5, and 4-6 show sound levels as a function of barrier height, absorptive characteristics and distance from the barriers.

The acoustical barriers used for the Northern Yard study are commercially available modular panels manufactured by IAC. The panels were IAC No. 1 shield regular panels with a 0.032 mm polyethylene film covering to protect the acoustical material from moisture. The noise shield panels were 10 cm.

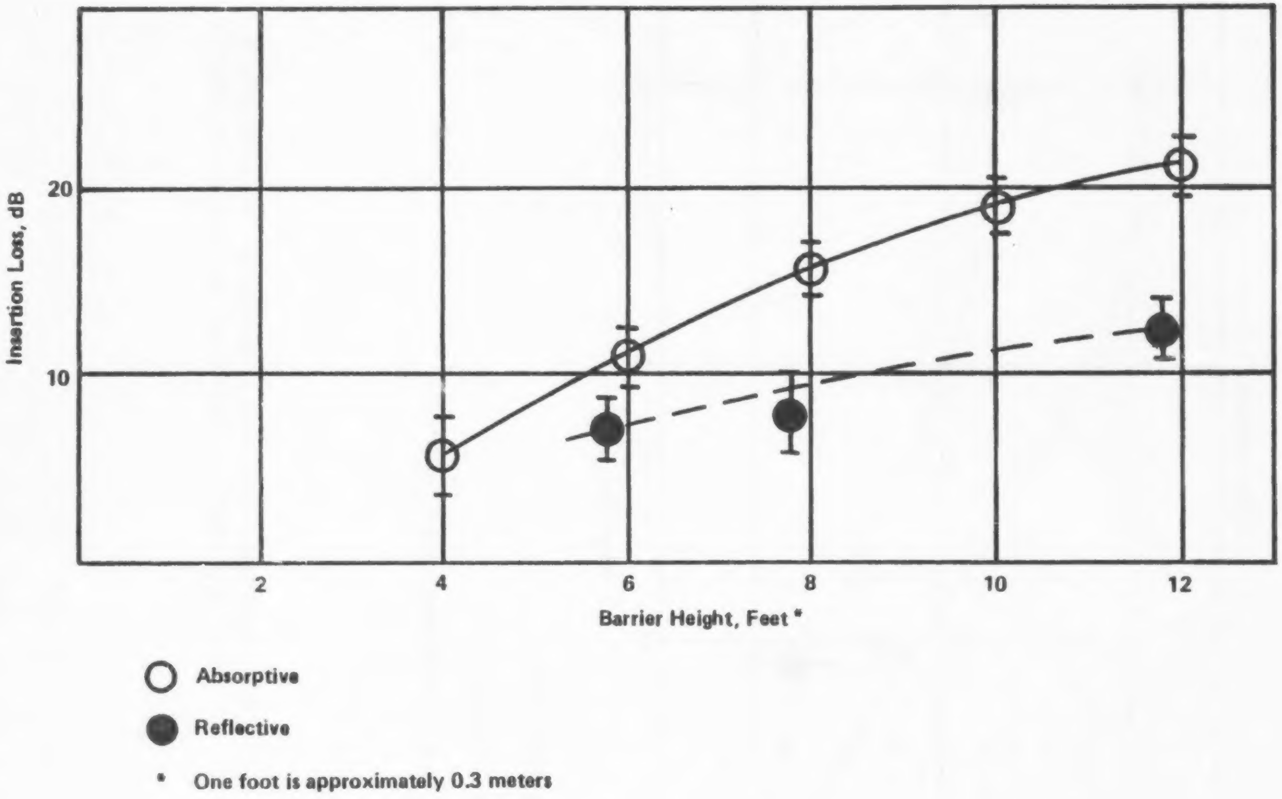


FIGURE 4-4 INSERTION LOSS OF RETARDER BARRIER AS A FUNCTION OF BARRIER HEIGHT (100 FEET FROM BARRIER AT 90 DEGREES)

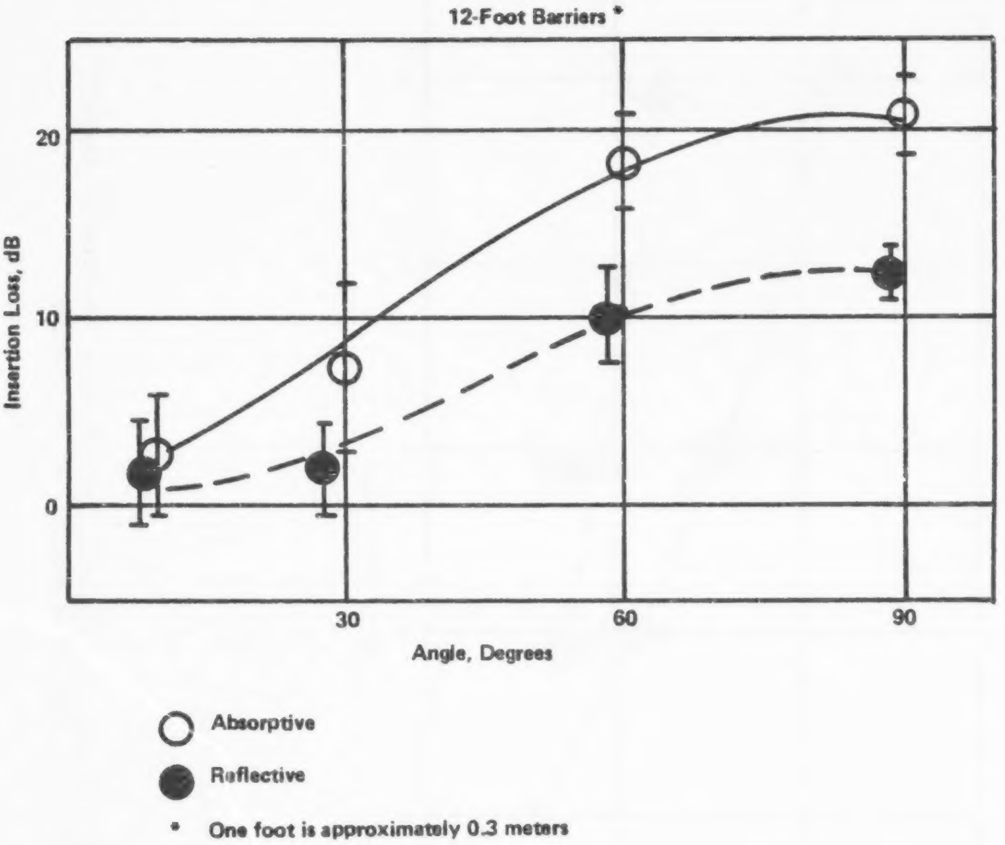
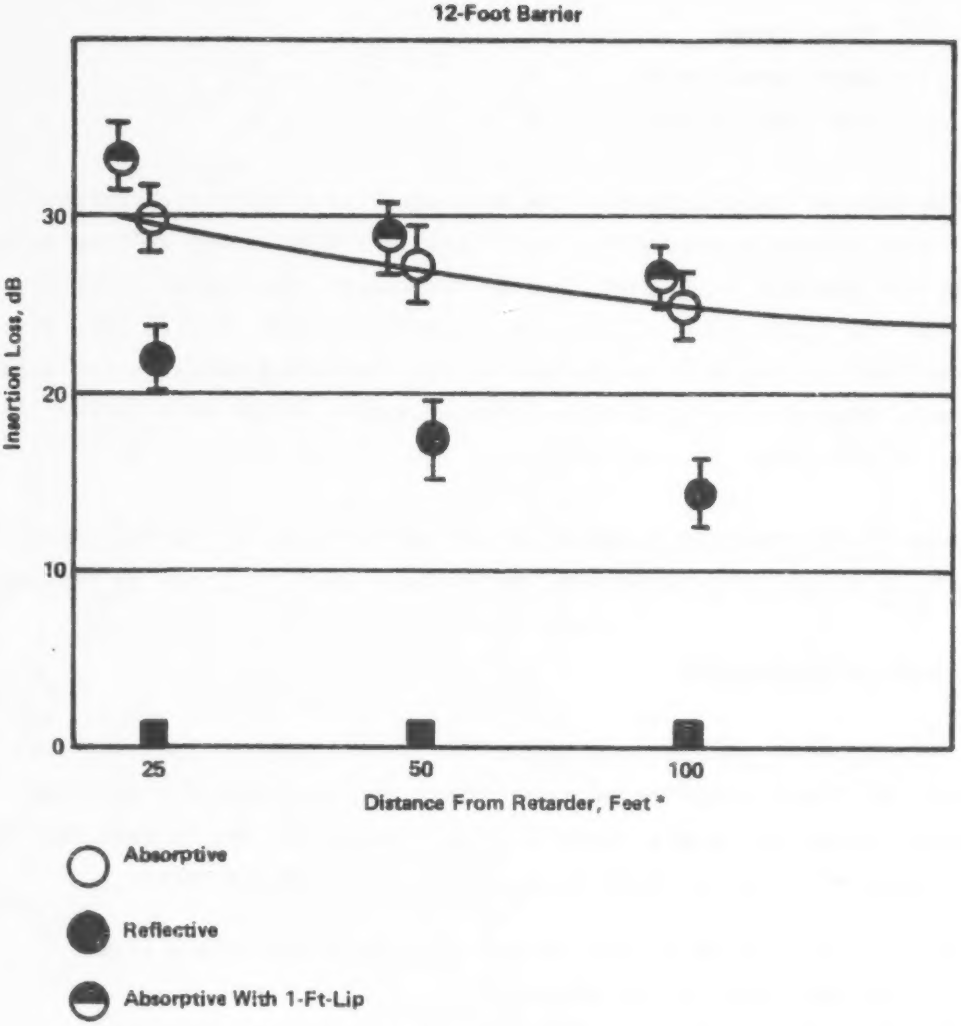


FIGURE 4-5 INSERTION LOSS OF 12-FOOT BARRIERS, AS A FUNCTION OF ANGULAR LOCATION (100-FOOT EQUIVALENT DISTANCE)



* One foot is approximately 0.3 meters

FIGURE 4-6 INSERTION LOSS OF 12-FOOT-HIGH BARRIERS, WITH 11-FOOT-LONG EXTENSIONS, AS A FUNCTION OF THE DISTANCE FROM THE RETARDER TO THE OBSERVER AT 90 DEGREES

thick and had standard sizes of width times length ranging from 16 x 60 inches to 48 x 168 inches (41 x 152 cm to 122 x 427 cm). The back surfaces were 18 gauge steel. The perforated surface was installed facing the retarder. The acoustic fill is an inert, mildew resistant, vermin proof mineral wood material with a UL fire hazard classification per ASTM specification of E-84 as follows:

Flame spread	15
Smoke development	0
Fuel contributed	0

The barrier construction at the Northern Yard consisted of vertical panels with support provided by 5 inch (12.7 cm) wide flange columns anchored to concrete footings at 11 foot (3.3 m) intervals. The column lines were 9 feet - 10 1/2 inches (2.9 m) from the track centerline. A plan view of the retarder/barriers and a cross section of the concrete foundation are illustrated in Figure 4-7. As indicated the effective height of a 12 foot (3.7 m) barrier is just under 10 feet (3m).

Some of the reported findings on barrier performance and the affect of barriers on system operations from the Northern yard study are as follows:

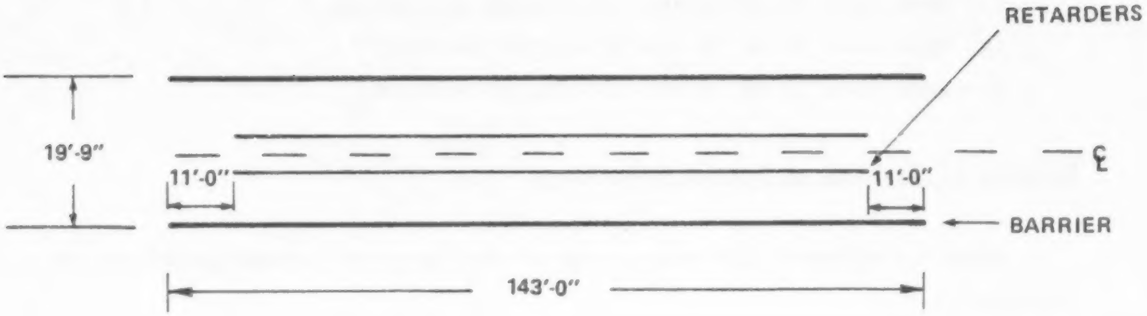
Assessment of Performance

The absorptive barrier configurations investigated can provide substantial far-field reduction of noise caused by operation of a railroad retarder. Insertion losses measured in this study for the 12 foot (3.7 m) high barrier with lip and with 22 foot (6.7 m) extensions were:

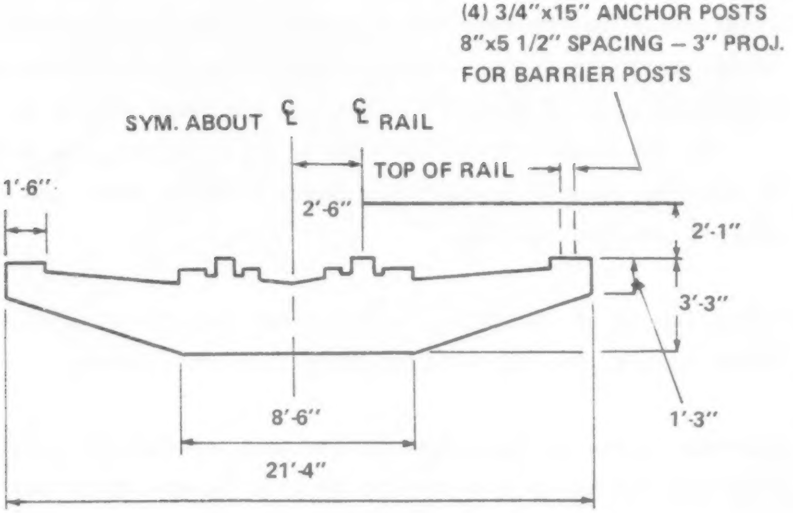
a. More than 25 dB on the barrier transverse centerline (i.e., perpendicular to the tracks),

b. More than 23 dB in the 60 degree sectors centered on the transverse centerline,

c. More than 13 dB in the 120 degree sectors centered on the transverse centerline.



RETARDER/BARRIERS PLAN VIEW



RETARDER/BARRIER FOUNDATION

FIGURE 4-7 RETARDER/BARRIER PLAN VIEW AND FOUNDATION

Corresponding insertion losses for the "normal" 8 foot (2.4 m) high barrier with 11 foot (3.4 m) extensions beyond the end of the retarder were:

1. More than 20 dB on the transverse centerline,
2. More than 13 dB in the 60 degree sectors,
3. More than 10 dB in the 120 degree sectors.

Effects of Barrier on System Operations

Negative effects inherent in use of the barriers investigated are as follows:

a. Signal personnel are restricted in performing repair or replacement of retarder parts in that access can be gained only by use of doors located in the barrier opposite the retarder mechanism, through the open ends of the barrier, through use of a crane or by removal of the barrier panels.
b. Derailments in the retarder are more difficult to clean up, and damage to the barriers usually occurs during derailments.
c. Personnel working within the barrier confines cannot be readily seen by the Hump Control Operator. To eliminate the possibility of injury, special precautions must be taken above and beyond those normally required.

Positive effects of barriers, beyond those associated with control of retarder noise propagation to the community, are as follows:

1. Retarder noise is decreased in the area around the retarder. Although this may not be of significant benefit in the Northtown Yard, it could well be in cases where personnel need to work close to an operating retarder, particularly if no other type of retarder noise suppression is in use.
2. Barriers serve to contain the emulsified oil spray used as part of the computerized retarder noise suppression system in use at the Northtown Yard.

3. Barriers provide weather protection, acting as a snow break for this retarder and wind break for personnel working within their confines.

In addition to barriers, lubrication systems are being employed by Burlington Northern at their Northtown yard. The lubrication system consists of a series of nozzles on a header pipe running down both sides of each rail with a concrete trough below the rail to collect the runoff. A water soluble oil solution of less than two percent oil is employed. A mixture of ethylene glycol is added in winter to keep the water from freezing. The lubricant is collected in a retrieval system and cleaned for reuse. Approximately three gallons of the dilute mixture is sprayed per car when the system is operating. At least 50 percent and maybe as high as 75 percent of the mixture is recoverable. The consumption of oil may be as low as 75 gallons per day. The system eliminates retarder squeal as a significant noise source by reducing the frequency of the stick-slip action.

Ductile iron shoes, cast with free spheroidal graphite dispersed throughout the metal, are also being employed to reduce the frequency of retarder squeal. At the Southern Pacific's West Colton yard[9], squeal frequency dropped from 53 percent with the standard steel shoes to 17 percent with ductile iron shoes (inside shoe only).

Inert Retarders

Inert retarders are generally located at the end of each track used for classification. Their function is to hold the block of cars being assembled from rolling out of the bottom of the yard. Inert retarders are either constant retardation spring-type or the self-energizing, weight sensitivity controlled-type. A squeal is produced when a block of cars is being pulled out of the classification tracks so that the duration of squeal from the inert retarder is considerably longer than that of the master or group retarder. Noise from inert retarders can be eliminated by replacing inert retarders with commercially available releasable-type retarders which allow cars to pass freely when the release is activated.

Car Coupling Noise

Car impacts constitute one of the most randomly distributed sources of noise in the railroad yard. As a railroad car rolls along the track into the classification yard, it may be stopped by an inert retarder, collide with a stationary car, collide with a string of cars coupled to the restrained car (causing a chain reaction of impacts) or it may overtake one or more cars that are not restrained.

The noise level produced in car-car impacts varies according to the different configurations, relative speed of cars, type of cars, type of coupler (cushioned or non-cushioned), weight of cars, size and weight of load. Little is known about the contribution of each of these factors to the total car-coupling noise level, however, the relationship of car speed to total coupling noise has been measured by EPA for a number of actual and simulated operating conditions. The results are presented in Appendix H. Practical approaches to reducing coupling noise impact may be limited at present to keeping car speeds to minimum levels required for coupling and reducing nighttime classification operations in residential areas.

Refrigerator Cars

The railroad industry has gradually been changing over from block ice-cooled perishable transport cars to closed-system, diesel engine-driven, mechanical-refrigerator cars. While awaiting transit, refrigerator units are kept running continuously. During this period, they are often parked near the perimeter of rail yards in large blocks consisting solely of these units.

The principal source of noise in the refrigeration cars is the diesel engine that drives the electrical generator for the compressor. The engines appear to have adequate exhaust muffling so that further noise reductions would likely require the addition of a baffle blocking the outside direct line of sight to the engine and the application of sound absorptive foam in the engine compartment.

Repair Facilities, Load Cell Testing and Locomotive Service Areas

In the United States there are approximately 216 locomotive and repair facilities located on or in close proximity to yards. When diesel-electric locomotives undergo major engine service or repair, they are generally subjected to a series of static performance tests and inspections. These tests include engine performance under load. Locomotives can be load tested at all throttle settings including full power by routing the electrical power generated into resistor banks termed "load boxes" adjacent to the test site. This load test is usually conducted in the service rack facility, generally in the vicinity of the engine shop area. Load test facilities are operated on a 24-hour per day basis.

In addition to the repair facilities, the locomotives go through a routine maintenance inspection at a service area. This servicing primarily includes washing, sanding, fueling and analysis of the lube oil. Other minor underbody inspections and lubrications may also be performed. The main source of noise at the service and repair areas can be attributed to the idling locomotives clustered in the facility at any given time.

Reducing noise impacts from repair facilities, and load cell testing and service areas may require construction of large barriers or enclosure of the testing area. Where enclosure or barriers are impractical because of the size of the area, relocation of the test area to greater distances away from property lines will reduce property line noise levels.

Wheel/Rail Noise

The four main sources of wheel/rail noise are: squeal, impact, roar and flange rubbing. The major wheel/rail noise emissions are associated with mainline operation and have levels which increase with train speed; however, wheel squeal is occasionally a yard problem and can occur at very slow speeds. Wheel squeal and flange rubbing occur when a train negotiates a tight curve.

The squeal noise from tight curves in yards can be mitigated by use of automatic rail oilers, and local barriers along tight curves.

Miscellaneous Sources

Railroad yards contain various miscellaneous sources of noise. Among these are loudspeakers, horns and whistles. These noises are different in nature from most other types of railroad noise because they are primarily used intentionally as warning devices to convey information to the receiver rather than being unwanted by-products of some other activity. They are regulated at the Federal and State levels as safety devices rather than noise sources.

NOISE CONTROL FOR ALTERNATIVE REGULATORY OPTIONS

The noise control technology for railyard noise sources has been analyzed for specific regulatory options. The noise control options presented are believed to reflect the most practical approaches for the noise sources considered. These approaches take into account difficulties which arise due to operational problems including constraints imposed by yard geometries and safety considerations. The options considered are for the following sources:

Active retarders
Locomotive load cell test standards
Car coupling
Switcher locomotives

Regulatory sound levels associated with the various options are presumed to be measured at the receiving property in accordance with the measurement procedures described in Appendix A.

Options for Retarder Noise Reduction

Of the three methods for reducing retarder noise which have been discussed previously, only barriers significantly reduce the intensity of the retarder squeals. Lubrication systems and ductile iron shoes both reduce the frequency of squeals but are ineffective in lowering the peak noise levels when squeals occur.

Although retarder barriers have been found very effective in reducing peak noise levels, their use around group retarders may be limited because of space limitations arising from close trackage. Industry sources claim that construction would be impossible around 50% of the group retarders.[10] However, close trackage and clearance problems rarely occur at the master retarder so that noise absorptive barriers can almost always be placed at those sites. To reduce the sound level of squeals from group retarders at receiving property, barrier walls can be constructed along the rail property boundaries. Assuming the railyard geometries identified in Section 3, reflective barrier walls of 10 to 15 feet (3.0 to 4.6 meters) in height and 1500 feet (457 meters) in length would reduce maximum levels by 10 to 20 dB at the receiving property. The barrier walls can be wooden or masonry with construction similar to that now commonly used for noise control along highways. Three specific retarder noise options with receiving property regulatory limits and corresponding noise control measures have been analysed. These are:

Option	Receiving Property Limit (dB)	Noise Control
1	94	8 ft x 1500 ft (2.5 m x 457 m) barrier wall at boundary nearest the master retarder and 8 ft x 1500 ft (2.5 m x 457 m) wall along the opposite boundary.
2	84	15 ft x 1500 ft (4.6 m x 457 m) barrier wall at boundary nearest the master retarder and 10 ft x 1500 ft (3.0 m x 457 m) wall along the opposite boundary.
3	83	In addition to treatment listed in Option 2, 12 ft x 150 ft (3.7 m x 45.7 m) absorptive barriers are placed around the master retarder.

The noise control measures assume a baseline average max A-weighted sound level from retarder squeal of 111 dB at 30 meters. For the typical low volume hump yard, which is the worst case (retarder nearest to property line), the master retarder is 64 meters from the near side property lines. The group retarders also average 64 meters from nearest property line although they are distributed - - some closer and others further away. The reduction in sound levels due to the insertion of barrier walls at the property line can be estimated by treating the retarders as a point source and assuming a barrier attenuation[11] (A_b) of:

$$A_b = \begin{cases} 10 \log \left(\dfrac{\sqrt{2\pi N}}{\tanh \sqrt{2\pi N}} \right) + 5 & N \geq -0.2 \\ 0 & N < -0.2 \end{cases}$$

where:

$N = \pm (2/\lambda)(A + B - d)$

is the acoustic wave length for retarder squeal (approximately 0.15 m)

$A + B - d$ = path length difference between the shortest distance over the barrier to the receiver, and the straight line distance from the source to the receiver.

The receiving property is assumed to be 15 meters beyond the wall. The sound level at the receiving property is estimated by subtracting the barrier attenuation plus air/ground attenuation (0.33 dB/m) from the noise levels that would otherwise occur at the receiving property.

Although the insertion loss achievable with absorptive barriers at the master retarders is approximately 20 dB, the average A-weighted maximum retarder sound levels at the property lines will be only slightly reduced by those barriers since the property line levels result from the combined effect of both the master and group retarders.

Options for Load Cell Test Noise Reduction

Where load cell testing can not be positioned sufficiently distant from the property line to reduce load test noise to acceptable levels, enclosures or barriers can provide the necessary noise control. Unless a facility enclosure is desired for reasons beyond noise reduction, it is probable that barriers will be the preferred treatment. Absorptive barriers, 7.6 meters high and similar in construction to those which have been described in detail for the master retarders will provide approximately 15 dB reduction in the maximum load test A-weighted noise levels. Since there is a large low frequency component in locomotive noise emissions (See Figure 4-3) sound absorbing masonary blocks should also be considered for barrier construction material to better attenuate annoying low frequency sound.

Two options with receiving property regulatory limits and corresponding noise control measures have been analyzed. They are:

Option	A-Weighted Receiving Property Limit (dB)	Noise Control
1	67	Absorptive barriers 20 ft x 150 ft (6.1 m x 45.7 m) placed 25 ft (7.6 m) from track certerline.
2	65	Absorptive barriers 25 ft x 150 ft (7.6 m x 45.7 m) placed 25 ft (7.6 m) from track centerline.

The noise control measures assume a baseline load test A-weighted sound level of 90 dB at 30 meters. The expected worst case occurs in flat yards where the load test cells average 92 meters from the nearest property lines. The accoustic center for the load test noise is assumed to be located approximately 3.6 meters above ground level. The insertion losses for the two cases are conservatively estimated at 13 and 15 dB corresponding to the 20 feet and 25 feet (6.1 and 7.6 meters) high barriers.

Options for Switcher Engine Noise

The most practical approach to reducing noise from switcher engines is to retrofit the engines with exhaust silencers. The reduction achievable through the use of silencers will vary slightly from model to model due to variations in component noise emissions for each model. However, the investigations which have been conducted indicate that exhaust noise is a major contributor to locomotive noise, expecially at high throttle settings. As part of the proposed interstate rail carrier regulation docket, industry provided data indicating that little or no reduction was achieved on two switcher models when the engines were tested at idle. Reductions of 3 to 5 dB A-weighted were recorded at the higher trottle settings. The models tested were EMD MP15AC and EMD SW1001. These relatively low horsepower engines, 1500 HP and 2000 HP respectively, are typical in operating characteristics of models designed specifically for the purpose of switching. Measured sound levels with and without silencers are shown for each throttle setting in Table 4-2. The results shown in Table 4-2 coupled with the fact that switchers spend much of their time at low throttle settings indicate that for most of the operating time the reductions in switcher noise levels will be nominal. However, the measured noise levels at idle are only 65 dB at 30 meters and significant noise reductions do occur when the engines operate at throttle settings that produce their peak noise levels.

An important factor to consider for a retrofit program is the availability of space for positioning a muffler. A detailed evaluation of space availability was conducted for the 1975 rail carrier regulation and appears in the 1975 Background Document[1] as Appendix I. The results of that evaluation indicate that sufficient space is available above the hood for models designed as switchers. For road engines that are used as switchers the availability of space above the hood is less certain. In some instances exhaust manifolds may need to be enlarged and the muffler installed under the hood. It is also possible that some units have been modified in ways that make muffler installation difficult. In tests conducted by the Donaldson Company for the AAR on two road locomotives, EMD models SD 40-2 and GP 380-2, reductions in total noise emissions were again less at the lower throttle settings than at high throttle settings, however, on the SD-40-2 a 5.5 dB reduction in A-weighted levels were recorded at 30 meters at throttle setting 2. Although the mufflers used in the study were large (18 dBA reduction at 1 meter) and would not fit the confines of the locomotives, the report concluded that a smaller muffler (10 dBA reduction at 1 meter) would result in the same overall noise reduction at 30 meters as the larger muffler. The test results are indicated in Tables 4-3 and 4-4.

The regulatory options considered to reduce noise from switcher engines would limit the maximum sound levels measured at 30 meters. Differing maximum sound levels would be permitted for idling and moving modes of operation. Two specific options have been analyzed. They are:

Option	A-weighted Regulatory Levels (dB)		Noise Control
	Idle	Moving	
1	70	90	Muffler retrofit
2	67	88	Muffler retrofit

The available data indicate that Option 1 would require no noise control at all for most switchers. Option 2 appears to be right at the level where abatement will be required for the noisier engines. Although the level at idle, for Option 2 would be 2 dB above the current energy averaged sound levels, the existing variation about the average along with measurement uncertainties (± 1.5 dB) will require that a substantial part of the switcher fleet be retrofited with exhaust silencers.

Options for Reducing Car Coupling Noise

Two of the regulatory options considered for reducing car coupling noise are based on expected average coupling noise levels associated with car coupling speed limits. The remaining options are based on car coupling speed limits, but provide noise limit waivers when car coupling occurs below designated limit speeds. The specific regulatory options are:

Table 4-2

END SWITCHER LOCOMOTIVE SOUND LEVELS WITH AND WITHOUT SILENCERS*

Throttle Position	Low Idle	Idle	Idle	1	2	3	4	5	6	7	8
Cooling Fan	ON	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
MP25AC with spark arrester manifolds	63	65	65	63	73	78	81	83	85	87	90
MP25AC with spark arrestor/silencer	63	65	65	68	72	75	78	80	82	84	85
Raditor shutter position	OPEN	OPEN	CLOSED	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
SW 1001 with spark arrestor manifolds		65	65	66	73	77	79	80	84	86	89
SW 1001 with spark arrestor/silencer		65	65	66	72	76	78	82	82	83	86

*Single unit sample A-weighted sound levels in dB - slow response central tendency, 100 ft (30 m) to the side of the locomotive on a stationary load test. Source: EMD.

Table 4-3

SUMMARY OF LOCOMOTIVE MUFFLER ACOUSTICS TESTS

SD 40-2 Locomotive, BN Road 6332

	Locomotive without Muffler		Locomotive with Muffler			
Throttle Setting	Noise Level @ 30 m (dB)	Number of Fans Running	Noise Level @ 30 m (dB)	Number of Fans Running	Reduction in Total Locative Noise @ 30 m (dB)	Reduction in Exhaust Noise @ 1 m (dB)
Idle (no load)	65.6	1	64	1	1.5	18.5
1	66.5	1	64	1	2.5	18.5
2	72	1	66.5	1	5.5	17
3	74	1	68	1	6	18
4	77.5	1	71	1	6.5	19
5	84.5	1	74.5	1	10	18
6	84.5	1	76	2	8.5	16
7	85	2	80	2	5	19
8	85	2	81	2	4	19

Notes:

1. Ambient noise levels: 47-55 dB(A)
2. Ambient temperatures: 80-90°F
3. Wind Speed: 10-20 mph
4. Sound levels are A-weighted.

Table 4-4

SUMMARY OF LOCOMOTIVE MUFFLER ACOUSTICS TESTS

GPD 38-2 Locomotive, BN Road 2092

	Locomotive without Muffler		Locomotive with Muffler			
Throttle Setting	Noise Level @ 30 m (dB)	Number of Fans Running	Noise Level @ 30 m (dB)	Number of Fans Running	Reduction in Total Locative Noise @ 30 m (dB)	Reduction in Exhaust Noise @ 1 m (dB)
Idle (no load)	60.5	1	60.5	1	0	18
1	64	1	62	1	2	16
2	68	1	65.5	1	2.5	18
3	73	1	67	1	6	19
4	78	1	72	1	6	19
5	79	1	75	1	4	16.5
6	82	1	75	1	7	18
7	84.5	1	79	1	5.5	17
8	86.5	1	81	2	5.5	17.5

Notes:

1. Ambient noise levels: 54-55 dB(A)
2. Ambient temperatures: 80-95°F
3. Wind Speed: 10-30 mph
4. Sound levels are A-weighted.

Options	A-weighted Regulatory Limit*	Exception Condition
1	91	less than six mph
2	91	none
3	85	less than four mph
4	92	none
5	92	less than eight mph

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*Measured at receiving property.

Based on the noise data presented in Appendix H, the energy average sound levels of railcar impacts can be described by the following relationship.

$$\overline{L_{max}} = 75 + 32.5 \log v \qquad (1)$$

where $\overline{L_{max}}$ is based on the fast meter response in dB at (30 meters) and v is in mph.

It is the relationship between average maximum sound level and car coupling speed that provides the basis for impact reduction. The current practice is for railcars to be coupled at speeds distributed over a several mph range. Data provided by Conrail indicate the average speed recorded for 60,958 measurements taken at 7 classifications yards was 4.75 mph. The distribution of impacts as a function of railcar speed at impact is given in Table 4-5.

Table 4-5

DISTRIBUTION OF RAILCAR IMPACTS

Speed (mph)	Percentage of Impacts in Speed Interval
0-2	1.1
2-3	4.8
3-4	13.2
4-5	24.2
5-6	31.2
6-7	13.8
7-8	6.2
8-9	3.2
9-10	1.3
10-11	0.5
11-12	0.2
12-18	0.1

As the percentage of rail cars in excess of a given speed (4,6 or 8 mph) is reduced, the average velocity level is reduced and the expected sound level is correspondingly reduced. It is estimated that eliminating speeds in excess of 6 mph will reduce A-weighted average max levels 1 to 2 dB; while restricting coupling speeds to less than 4 mph would reduce the levels by 7 to 8 dB.

It is probable that a reduction of coupling speed to less than 4 mph would require a considerable increase in control effort on the part of switch engine operators. In many yards where the classification area is slope graded to aid rail car rollability, switch engine operators might need to push cars much closer to the point of coupling rather than letting them roll free for several car lengths as is the current practice.

SUMMARY

The noise source level reduction achievable for specific sources considered in the regulatory source options are summarized in Table 4-6.

A summary of noise control treatments for the options appears in Table 4-7, and estimated noise levels at the receiving property after source treatment are presented in Tables 4-8, 4-9, 4-10, and 4-11.

Table 4-6

NOISE SOURCES AND SOUND LEVEL REDUCTIONS

Noise Sources		Noise Control Techniques	Range of Reduction in A-Weighted Sound Level (dB)*
Retarders (Master)		Absorptive Barriers 150 ft x 12 ft (46 m x 3.7 m)	16-22
Retarder (Master or Group)	(a)	Reflective Boundary Walls 1500 ft x 8 ft (457 m x 2.5 m)	9-11
	(b)	Reflective Boundary Walls 1500 ft x 15 ft (457 m x 4.6 m) 1500 ft x 10 ft (457 m x 3 m)	16-21
Load Cell Test	(a)	Absorptive Barriers 150 ft x 20 ft (45.7 m x 6.1 m)	12-14
	(b)	Absorptive Barriers 150 ft x 25 ft (45.7 m x 7.6 m)	14-16
Switcher Engine Noise		Exhaust Silencer	0-1 at idle 1-5 moving
Car Coupling	(a)	Reduce coupling speeds to less than 4 mph	7-8
	(b)	Reduce coupling speed to less than 6 mph	1-2
	(c)	Reduce coupling speeds to less than 8 mph	0-1

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* These are the expected ranges of reduction in maximum sound levels for single events depending on the type of noise source, the distance from the sound to yard boundary and other factors. In the case of retarders, the reductions shown are the barrier insertion loss values; the overall noise reductions will be less due to finite barrier effects. The reductions in terms of the L_{dn} scale for each option or type of source are discussed in Section 5.

Table 4-7

SUMMARY OF NOISE CONTROL TREATMENT

Retarders	
T_1	Barrier walls 1500 ft x 8 ft (457 m x 2.5 m) near side and 1500 ft x 8 ft (457 m x 2.5 m) far side
T_2	Barrier walls 1500 ft x 15 ft (457 m x 4.6 m) near side and 1500 ft x 10 ft (457 m x 3.0 m) far side
T_3	In addition to T_2, 150 ft x 12 ft (45.7 m x 3.7 m) absorptive barriers are placed around the master retarder
Load Cells	
T_4	Absorptive barriers 150 ft x 20 ft (45.7 m x 6.1 m) placed 25 ft (7.6 m)from track centerline
T_5	Absorptive barriers 150 ft x 25 ft (45.7 m x 7.6 m) placed 25 ft (7.6 m) from track centerline
Switch Engines	
T_6	Exhaust Silencer
Car Coupling	
T_7	Reduce rail car coupling speeds to less than 4 mph
T_8	Reduce rail car coupling speeds to less than 6 mph
T_9	Reduce rail car coupling speeds to less than 8 mph

Table 4-8

ESTIMATED NOISE LEVELS FOR RETARDERS

Yard type and traffic rate	Distance to nearest receiving property* (m)	Baseline A-Weighted Levels (dB)	Levels Achieved by treatments** (dB) T_1***	T_2	T_3
Hump					
Low volume	79 m	104	94	84	83
Medium volume	110 m	100	90	80	79
High volume	128 m	98	88	78	77

*15 m beyond assumed property line

**Under the proposed measurement methodology for compliance determination the levels listed would be adjusted for activity in accordance with adjustment factors listed in Table 2 of Appendix A.

***Treatment code shown in Table 4-7.

Table 4-9

ESTIMATED NOISE LEVELS FOR LOAD CELL TESTS

Yard type and traffic rate	Distance to nearest receiving property* (m)	Baseline A-Weighted Levels (dB)	Levels Achieved by treatments** (dB)	
			T_4	T_5
Hump (High volume only)	128	78	65	63
Flat (High volume only)	107	80	67	65

*15 m beyond assumed property line

**Under the proposed measurement methodology for compliance determination the levels listed would be adjusted for activity in accordance with adjustment factors listed in Table 2 of Appendix A.

Table 4-10

ESTIMATED NOISE LEVELS FOR CAR COUPLING

Yard type and traffic rate	Distance to nearest property line (m)	Baseline A-Weighted Levels (dB)	Levels Achieved by treatments* (dB)		
			T_7	T_8	T_9
Hump					
Low	210	89	81	87	88
Medimum	310	85	77	83	84
High	370	83	75	81	82
Flat					
Low	110	95	87	93	94
Medimum	110	95	87	93	94
High	300	86	78	84	85
Industrial	230	88	80	86	87
Small Industrial	170	91	83	89	90

*Under the proposed measurement methodology for compliance determination the levels listed would be adjusted for activity in accordance with adjustment factors listed in Table 2 of Appendix A.

Table 4-11

ESTIMATED NOISE LEVELS FOR SWITCHERS

Yard type		Measurement Distance (m)	Baseline A-Weighted Levels (dB)	Levels achieved by treatment (db) T_6
Proposed measurement	(Idle)	30	66	65-66
Methodology	(Moving)	30	90	85-89
Receiving property measurement for idling switcher				
Hump				
Low		64	59	58
Medimum		95	56	55
High		113	55	54
Flat				
Low		33	65	64
Medimum		33	65	64
High		92	56	55

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SECTION 5

HEALTH AND WELFARE IMPACT

INTRODUCTION

Benefits to Public Health and Welfare

The phrase "health and welfare", in this analysis and in the context of the Noise Control Act, is a broad term. It includes personal comfort and well-being, and the absence of mental anguish, disturbance and annoyance, as well as the absence of clinical symptoms such as hearing loss or demonstrable physiological injury. In other words, the term applies to the entire range of adverse effects that noise can have on people, apart from economic impact.

Improvements in public health and welfare are regarded as benefits of noise control. Public health and welfare benefits may be quantified both in terms of reductions in noise exposures and, more meaningfully, in terms of reductions in adverse effects. This analysis first quantifies rail facility noise exposure (numbers of people exposed at different noise levels), then translates this exposure into a community impact.

People are exposed to noise from rail facilities in a variety of situations. Some examples are:

1. Inside a home or workplace
2. Outdoors, at home or in commercial and industrial areas
3. As a pedestrian, or participant in recreational activities

Effects of Noise on People

Noise affects people in many ways, although not all noise effects will occur at all levels. Rail facility noise may or may not produce the effects mentioned below, depending on exposures and specific situations. The discussion here refers to noise in general.

The best-known noise effect is probably noise-induced hearing loss. Noise-induced hearing loss characteristically that it first occurs in the high-frequency area of the auditory range which is important for the understanding of speech. As a noise-induced hearing loss develops, the sounds of speech which lend meaning become less and less discriminable. Eventually, while utterances are still heard, they become merely a series of low rumbles, and the intelligibility is lost. Noise-induced hearing loss is a permanent loss for which hearing aids and medical procedures cannot compensate.

Moreover, noise is a stressor. The body has a basic, primitive response mechanism which automatically responds to noise as if to a warning or danger signal. A complex of bodily reactions (sometimes called the "flight-or-fight" response), which is mostly beyond conscious control, takes place. When noise intrudes, reactions such as elevation of blood pressure, changes in heart rate, secretions of certain hormones into the bloodstream, changes in digestive processes and increased perspiration on the skin may occur.

This stress response occurs with individual noise events, but it is not yet known to what extent the reactions seen in the short term become, or contribute to, long-term stress disease such as chronic high blood pressure. Therefore, the stress response to noise cannot yet be quantified.

On the other hand, some of this stress response may be reflected in what people express as "annoyance", "irritation" or "aggravation". This analysis does quantify the generalized adverse response of people to environmental noise. To the extent that physiological stress and verbalized annoyance are related, the "general adverse response" quantity may be seen to partially represent or indicate the magnitude of stress response.

The general adverse response relationship to noise levels may also be seen as partially representing another area of noise effects: activity interference. Noise interferes with many important daily activities such as sleep and communication. In expressing the causes of noise annoyance, people often report that noise interferes with sleeping, relaxing, concentration, TV and radio listening and face-to-face and telephone discussions. Thus, the general adverse response quantity may be seen also as indicative of the severity of interference with activities.

Measures of Benefits to Public Health and Welfare

Because of inherent differences in individual response to noise, the wide range of rail facility configurations and environments, and the complexity of the associated noise fields, it is not possible to examine all situations precisely. Hence, in this predictive analysis, certain stated assumptions have been made to approximate typical, or average, situations. The approach taken to determine the benefits associated with alternative noise regulatory options is therefore statistical in that an effort is made to determine the order of magnitude of the population that may be affected at each "not to exceed" noise emission level. Some uncertainties with respect to individual cases or situations may remain.

In general, reducing rail facility noise levels at residential and commercial land uses is expected to produce the following benefits:

1. Reduction in railyard noise levels and associated cumulative long-term impact upon the exposed population.

2. Fewer activities disrupted by individual, intense noise or intruding noise events.

3. General improvement in the quality of life, with quietness as an amenity.

The approach taken for the analysis of health and welfare benefits resulting from various railyard noises abatement options was to evaluate the effects on the U.S. population of reducing noise levels at railyard boundaries by abating the noise emissions of the predominant noise sources in railyards. (One prominent source of railroad noise, line-haul noise (locomotives and railcars), is currently subject to federal noise emission regulations.[1,2])

The noise source limits in the current regulation are designed to be compatible with a subsequent, more comprehensive regulation in the sense that the noise descriptors used for specific standards here are compatible with the day-night sound level (L_{dn}). (See page 5-6.) The benefits (reduced impacts) calculated for each source are based on a railyard facility noise impact model which incorporates noise emissions from the dominant noise sources found in typical railyards. The latter portions of this section will first describe the railyard noise model, and then specify source reduction options and benefits.

Health and Welfare Impact Measures

In this analysis, no attempt was made to quantify the complexities of railyard noise exposures of people moving from environment to environment and activity to activity. Instead, the analysis quantifies residential noise levels and numbers of residents living within each different level of noise environment. This is appropriate to a quantification of a community's general adverse response to rail facility noise. In addition, the analyses were conducted according to standard procedures, on the basis of population information which indicated only the typical local average population densities mean railyards, but with no differentiation between various land uses such as residential and commerical. This, in effect, quantified the impact on the redidents of the area regardless of whether they participate in residential or commerical activities. However, as discussed in the final part of this section, these are other specific benefits to be gained from protection of commerical property from excessive noise that are not quantified by this procedure or model.

The health and welfare impact analysis uses a noise measure that integrates the sound pressure or energy fluctuations of the noise environment into a simple indicator of both sound energy magnitude and duration. This general measure for environmental noise is the equivalent or average A-weighted sound (noise) level, in units of decibels. The general symbol for equivalent sound level is L_{eq}. This indicator correlates well with the overall long-term effects of noise on the public health and welfare. The analytical expression for L_{eq} is:

$$L_{eq} = 10 \log_{10} \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p^2(t)}{p^2_o} \, dt \right]$$

where $t_2 - t_1$ is the interval of time over which the pressure levels are evaluated, p(t) is the time varying sound pressure of the noise and p_o is a standard reference pressure (20 micropascals). When expressed in terms of an A-weighted sound level, the equivalent sound level (L_{eq}) is expressed by:

$$L_{eq} = 10 \log_{10} \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t^2} 10^{L(t)/10} \, dt \right]$$

where, in general, $L(t) = 10 \log_{10} \left[\frac{p(t)}{p_o} \right]^2$

The impact of the cumulative noise environment on people is assessed in terms of the day-night sound level (L_{dn}) which is a noise rating scale developed by the EPA. L_{dn} is used as a rating scale for the daily (24-hour) sound exposure, and is based on L_{eq}. It incorporates a weighting applied to nighttime noise levels to account for the increased sensitivity or reaction of people to noise intrusion at night. Thus, L_{dn} is defined as the equivalent sound level during a 24-hour period, with a 10 dB weighting applied to the noise exposure or levels for the noise events during the nighttime hours of 10 P.M. to 7 A.M. This may be expressed by the following equation:

$$L_{dn} = 10 \log_{10} \frac{1}{T} \left\{ \int_{t_1}^{t_2} 10^{L(t)/10} \, dt + \int_{t_2}^{t_3} 10^{[L(t)+10]/10} \, dt \right\}$$

where $T=t_3-t_1$, t_1=7 A.M. on 1st day, t_2=10 P.M. and t_3 = 7 A.M. 2nd day.

When values for average or equivalent sound levels during the daytime and nighttime hours (L_d and L_n, respectively) are known, L_{dn} can be expressed as:

$$L_{dn}=10 \log_{10} \frac{1}{24} \left[15 \times 10^{L_d/10} + 9 \times 10^{(L_n+10)/10}\right]$$

where L_d is the L_{eq} for the period 7 A.M. to 10 P.M. and L_n is the L_{eq} for the period 10 P.M. to 7 A.M.

In the assessment of railyard noise impact, the L_{eq} and L_{dn} scales are used to estimate the response of people exposed to various levels of noise. There is some variability in the general adverse response measure due to a number of social and demographic factors. However, in the aggregate for residential locations, the average degree of the expressed annoyance of groups of people increases as the cumulative noise exposure, as expressed by a rating scale such as L_{dn}, increases. For example, the different forms of response to noise, such as hearing damage, speech disruption or other activity interference, and annoyance, were related to L_{eq} or L_{dn} in the EPA Levels Document[3]. For the purposes of this study, criteria based on L_{dn} presented in the EPA Levels Document are used. Furthermore, if the outdoor level of L_{dn}=55 dB (which is identified in the EPA Levels Document as requisite to protect the public health and welfare) is met, no adverse impact in terms of general annoyance and community response is assumed to exist on a statistical basis.

The community response data presented in Appendix D of the Levels Document show that the expected reaction to an identifiable source of intruding noise changes from "none" to "vigorous" when the day-night average sound level increases from 5 dB below the level existing in the absence of the intruding noise to 20 dB above the level before intrusion. For this reason, a level which is 20 dB above L_{dn} = 55 dB is considered to result in a near maximum impact on the people exposed. Such a change in level would increase the percentage of the population that is highly annoyed by 40 percent of the total exposed population. Further, the data in the Levels Document suggest that within these upper and lower bounds the relationship between impact and level varies linearly, i.e., a 5 dB excess (L_{dn}=60 dB) constitutes a 25 percent impact, and a 10 dB excess (L_{dn}=65 dB) constitutes a 50 percent impact.

For convenience of calculation, a function for weighting the magnitude of noise impact with respect to general adverse response (annoyance) has been used. This function, normalized to unity at L_{dn} = 75 dB, may be expressed as representing percentages of impact in accordance with the following equation:

$$FI = \begin{cases} .05(L-C) & \text{for } L > C, \\ 0 & \text{for } L < C. \end{cases}$$

L is the observed or measured L_{dn} of the environmental noise, and in this study the criterion level C is L_{dn}=55 dB. Note that FI can exceed unity at levels greater than L_{dn} = 75 dB.

Thus, relative to projected community response, the impact of railyard noise is expressed in terms of both extensiveness (i.e., the number of people impacted) and intensiveness (the severity of impact) by multiplying the FI value by the number of people (P) exposed for the corresponding noise level and area under consideration. This concept is illustrated and described in Figure 5-1. Additional explanation of the fractional impact procedure is given in Appendix G.

In a particular area, then, the equivalent noise impact (ENI_i),* or the number of people who are considered 100 percent affected, is given by:

$$ENI_i = FI_i \times P_i.$$

---

*Equivalent Noise Impact (ENI) was the term in use at the outset of this rulemaking action. It has since been changed to LWP, or Level Weighted Population. For the sake of consistency, "ENI" will continue to be used throughout this rulemaking. Likewise, the term "Fractional Impact" (FI) is used here instead of the more recent notation $W(L_{dn})$.

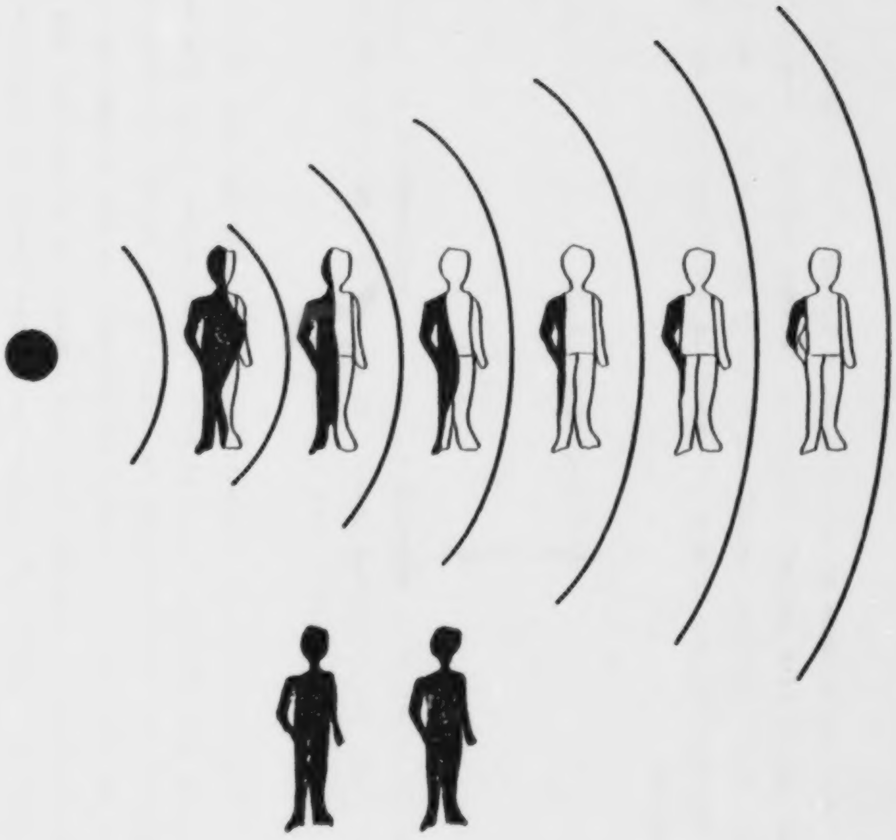
EQUIVALENT NOISE IMPACT: A METHOD TO ACCOUNT FOR THE EXTENT AND SEVERITY OF NOISE IMPACT

Equivalent Noise Impact (ENI) expresses both the extent and the severity of a noise impact. The extent of impact refers to the number of people who are adversely affected, while the severity represents the degree to which each person is affected. ENI provides a simple, single number used to compare benefits of different noise reduction options.

It has been determined that an outdoor L_{dn} value of 55 dB (or an indoor L_{dn} of 45 dB) represents the lower threshold of noise jeopardizing the health and welfare of people. In the range above these levels, noise may be a cause of adverse physiological and psychological effects. These effects often result in annoyance and community action. Above an L_{dn} of 75 dB, noise, in time, may cause hearing loss and the possibility of other severe health effects.

The computation of ENI allows one to combine the number of people jeopardized by noise above an L_{dn} of 55 dB with the degree of impact at different noise levels. The figure is a pictorial representation of the ENI concept. The circle is a noise source which emits noise to a populated area represented by the figures. The various partial amounts of shading represent various degrees of partial impact by the noise. Note that those people closest to the noise source are more severely threatened. The partial impacts are then summed to give the Equivalent Noise Impact. In this example, 6 people who are adversely affected by the noise (partially shaded) results in an Equivalent Noise Impact (ENI) of 2 (totally shaded).

FIGURE 5-1
EQUIVALENT NOISE IMPACT



Thus, for example, in a populated area where 1000 people are exposed to an L_{dn} (averaged over the area) of 60 dB, or an FI = 0.25, the noise impact is considered equal to 250 people 100 percent affected. Since L_{dn} from a given source varies with distance, the FI value will vary with distance also, and the total equivalent impact is obtained by integration of the summation of the ENI_i values in the successive increments of area out from the source. In the general form, the total equivalent impact rating is:

$$ENI = \sum_i P_i \times FI_i$$

Summary of Analysis

A railyard noise generation and propagation model was developed to assess the health and welfare impact due to noise from railyards. The impact assessment used the L_{dn} noise rating scale and the ENI rating procedure based on community annoyance response. The model included noise generation and propagation equations for each major railyard noise source identified. Railyard configurations and activity parameters were investigated to determine the distribution of noise sources, and the noise event occurrence rates and durations within the railyards. Baseline L_{dn} values, noise source to boundary distances and characteristic source lengths, where required, were determined for each source, and a computer model was developed to estimate both the baseline total population exposed to railyard noise and the number of people impacted by the railyard noise greater than the 55dB criterion level. In addition, the reductions in noise impact achieved were determined assuming a number of alternative noise reduction options (as discussed in Section 4).

RAILYARD DISTRIBUTIONS, CONFIGURATIONS AND NOISE SOURCES

Distribution and Numbers of Railyards

As a result of the identification and classification study of railyards discussed in Section 3 the four basic railyard categories used in the impact model were:

- Hump Classification Yards
- Flat Classification Yards
- Flat Industrial Yards
- Small Flat Industrial Yards.

The railyard types and locations were also grouped by the average level of activity (traffic rate) and the population size of the urban area in which the yard is located.

A summary of the railyard data discussed in Section 3 is shown in Table 5-1 by type of yard, place size of yard location and rate of traffic (activity). The distribution of yards by the six place size classes in Tables 3-11 and 3-12 was translated into the distribution shown in Tables 3-14 and 5-1 since the level of detail necessary to develop the noise impact model required only 3 place size classes.

Railyard Configurations and Noise Sources

The EPIC analyses discussed in Section 3 resulted in the derivation of the typical or average railyard configurations and dimensions shown in Figures 3-8 and 3-9. In essence the shapes of flat classification railyards are complex and asymmetrical, but can generally be considered to have separate receiving and departure areas with a wider classification and railcar storage area near the central part of the whole facility. The main operational area or traffic region in each of the subyard areas is not centered between the boundaries. It appears from visual observation (see EPIC analyses, Section 3) that some of the noise sources are nearer one side than the other. The configurations of the industrial and small industrial flat yards appeared to be somewhat simpler as indicated by Figure 3-9.

The analysis of types of noise sources to be considered in the noise impact model is also discussed in Section 3. In general there were 11 types of sources in hump yards, 8 types in flat classification yards and 4 types in the other yards. These noise sources are listed in Table 5-2.

Table 5-1

RAILYARD DISTRIBUTION BY YARD TYPE, PLACE SIZE AND TRAFFIC RATE CATEGORY

	NUMBER OF RAILYARDS												
	Place Size (Population)												
	Less Than 50,000				50,000 to 250,000				Greater Than 250,000				
	Traffic Rate				Traffic Rate				Traffic Rate				
Yard Type	Low	Med	High	Total	Low	Med	High	Total	Low	Med	High	Total	Total/Yard Type
I Hump Classification	19	19	14	52	14	12	8	34	13	16	9	38	124
II Flat Classification	321	204	104	629	135	83	44	262	115	70	37	222	1113
*III Industrial				849				239				293	1381
*IV Small Industrial				1262				133				156	1551
Total/Place size				2792				668				709	Grand Total: 4169

*Industrial and small industrial yards were not categorized by traffic rate.

Table 5-2

RAILYARD NOISE SOURCES

HUMP YARD - NOISE SOURCES:

- Mr - Master Retarders (Includes Group, Intermediate, and Track)
- HS - Hump Lead Switchers
- IR - Inert Retarders
- MS - Makeup Switchers
- CI - Car Impacts
- IL - Idling Locomotives
- LT - Locomotive Load Test
- RC - Refrigerator Cars
- IS - Industrial and Other Switchers
- OB - Outbound Trains (Road-Haul plus Local)
- IB - Inbound Trains

FLAT CLASSIFICATION YARD - NOISE SOURCES

- CSE - Classification Switchers, East End of Yard
- CSW - Classification Switchers, West End of Yard
- CI - Car Impacts
- IB - Inbound Trains
- OB - Outbound Trains (Road-Haul plus Local)
- IL - Idling Locomotives
- LT - Load Tests
- RC - Refrigerator Cars

FLAT INDUSTRIAL YARD - NOISE SOURCES:

- SE - Switch Engines
- CI - Car Impacts
- IB - Inbound Trains (Road-Haul plus Local)

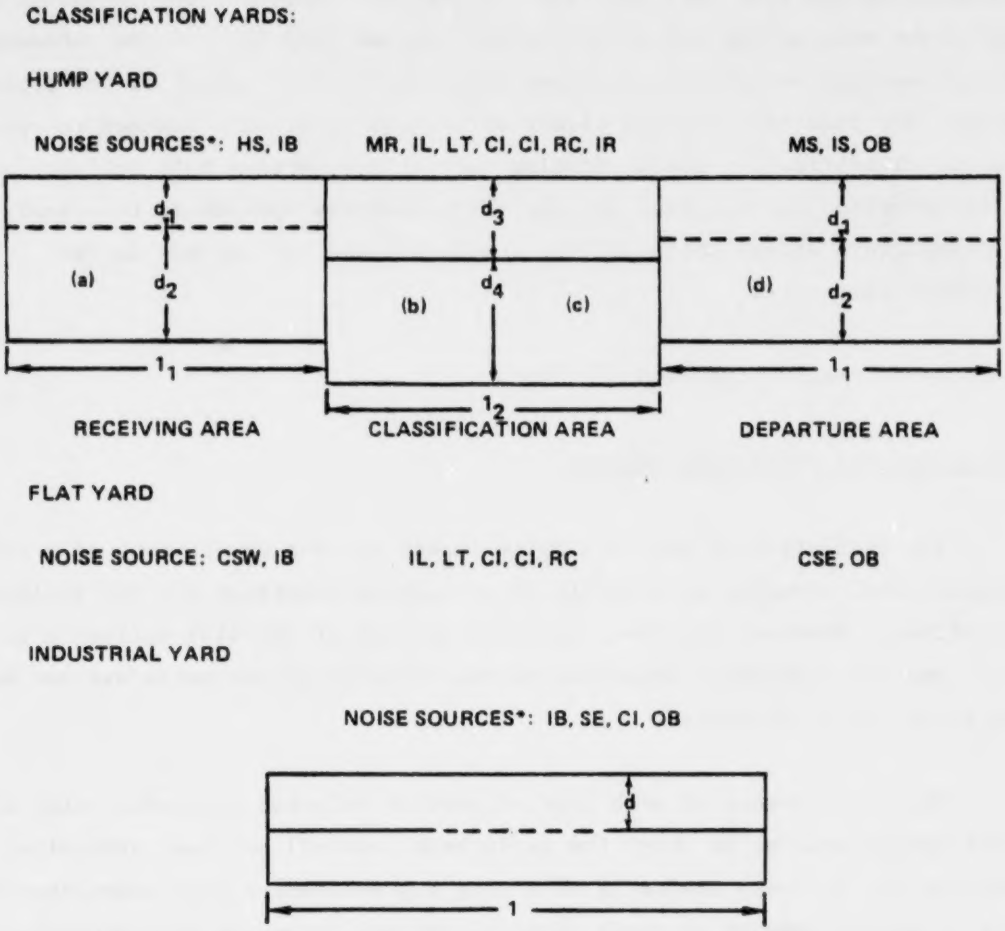
The general locations of noise source operations in the various yard types are indicated in Figure 5-2. There were insufficient data to determine the typical distances between types of sources and more specific locations of all the sources. Therefore it was assumed, for example, that in the hump classification yards the hump lead switch engines (HS) and inbound train (IB) locomotives operated back and forth in the full length of the receiving area, while the make-up and industrial switch engines (MS, IS) and the outbound train locomotives operated back and forth in the full length of the departure area. The remaining sources either were known to or were assumed to operate in the classification area. Similar data or assumptions hold for the flat classification yards. Thus all the moving sources operate in the receiving and departure areas, while all the stationary sources operate in the classification area.

POPULATION DENSITY ANALYSES

Local Average Population Density

The evaluation of railyard noise impact and the development of a noise impact model required an analysis of population densities for the railyard locations. However, the exact location of each of the 4169 railyards in the U.S. and the population densities in the vicinity of the yards was not known or practical to determine.

Since the number of each type of yard in selected population size classes (for cities near or in which the yards were located) had been determined (see Section 3), the only choice in obtaining representative population densities was to select samples of yards of each type and determine representative population densities by averaging the greater urban area average population densities for each place size class. It was recognized that these large scale average density values would not reflect the site specific land use patterns at railyards and thus did not represent railyard noise impacted residential area population densities.



*REFER TO TABLE 5–2 FOR SOURCE NAMES

FIGURE 5–2. GENERAL LOCATIONS OF NOISE SOURCES IN RAILYARDS

As discussed in Section 3, a decision had been made to randomly select a sample of railyards for determination of typical parameters needed to develop the noise impact model. Therefore in conjunction with the railyard configuration analyses, computerized census data were accessed to obtain site specific population data for each of the 120 railyards selected for examination. The objective was to obtain local average population densities in the areas adjacent to the railyards. These data were required to accurately assess the railyard noise impact in terms of equivalent number of people subjected to day-night average sound levels (L_{dn}) greater than 55 dB.

The population data were generated by Consolidated Analyses Centers, Inc. (CACI) using their Site II System data base and computer program which incorporate 1970 block level census data. This program accesses and summarizes the 1970 census at the block and block group levels and also estimates the 1977 population for the selected study areas based on such information as public utility connections and residential construction rates. The CACI system produced a Demographic Profile Report for each of the 120 railyards. Samples of these reports are shown in Appendix M, Figures M-1 and M-2.

Preliminary analyses indicated that railyard noise could affect populations within 2500 ft (762 m) to 5000 ft (1524 m) of the yard boundaries. Therefore, for each railyard the study area selected was rectangular in shape extending the length of the yard complex and either 2500 ft (762 m) or 5000 ft (1524 m) to either side depending on the size of the yard (i.e., 5000 ft (1524 m) for classification yards and 2500 ft (762 m) for industrial and small yards). In each case, the site specific or local average population density was obtained by dividing the computer estimated 1977 population (produced by the computer program) by the area within the rectangular coordinates (excluding the railyard area). The resulting average population density values are shown in Table M-3, Appendix M. As discussed in Appendix M, there were a few cases of yards in scarcely populated areas which did not contain a population centroid in the study area about the yard even though there may have been populated census tract blocks in the selected area. In these few cases the study area was expanded into the immediate vicinity to obtain a group of census block population data with which to compute an average density. Any uncertainty associated with these cases is insignificant relative to the total results from the impact model since the cases are few and the impact values are small.

Distribution of Railyards by Density Class

The percentage of sample railyards in each density class or range was computed, and these values are shown in Table 5-3.

The average density values and percentage distribution of railyards for the corresponding density range classes were assumed to hold for (or represent) the total population of railyards in the respective place size categories. Thus, for example, the percentage distribution of railyards in the smaller place size was assumed to hold for the yards in each yard category (type and traffic rate) in the small place size class shown in Table 5-1. Application of the percentage factors in Table 5-3 to the number of yards shown for each yard type shown in Table 5-1 results in the total number of railyards of each type estimated for each density class as shown in Appendix M, Tables M-4 through M-7.

RAILYARD NOISE MODEL

General Description

The noise sources identified in railyards include moving and stationary sources which have varying degrees of proximity to one another depending on the yard type, function and geometry. Some of the noise sources which contribute significantly to the overall noise environment are located or operated in specific areas of the yards while others may be randomly distributed in various sections of the yards. Even though many of the noise sources and activities can be characterized in terms of their operational parameters, such as usage time or rate of occurrence, and distribution during the daytime and nighttime periods, an accurate definition of the typical positions of source groupings relative to one another and to the

Table 5-3

PERCENTAGE OF SAMPLE RAILYARDS BY POPULATION DENSITY RANGE

Population Density Range (People/Sq Mi)*	**Place Size** Less than 50,000 People %	**Place Size** 50,000 to 250,000 People %	Population Density Range (People/Sq Mi)	**Place Size** Greater than 250,000 People %
<500	20	10.3	<1000	15
500 to 1000	15	12.8	1000 to 3000	25
1000 to 2000	32.5	15.4	3000 to 5000	32.5
2000 to 3000	17.5	17.9	5000 to 7000	5
3000 to 5000	5	25.6	7000 to 10,000	5
5000 to 7000	5	10.3	10,000 to 15,000	15.8
7000 to 11,000	5	7.7	15,000 to 22,000	10

* To convert to People/Sq Km multiply by 0.386.

railyard boundaries is not possible without considerable additional descriptive data on the 4169 railyards in the U.S. These data are not currently available.

Therefore, a noise generation model was developed for each identified source for which a noise data base was available. Due to the uncertainty in the noise source locations, the basic preliminary assumption made for the ENI analysis was that the noise levels on the periphery of railyard complexes were due to widely separated individual sources and groups of sources of the same type. Additionally, examination of the yard noise source characteristics indicated that only two types of basic noise generation models were necessary, one for stationary sources and another for moving sources. In the case of stationary or groups of like stationary sources, the corresponding average daily noise levels are a function of source strength and percentage of time operating or number of on-off events. For the moving sources, the average daily noise levels at any observation location are a function of source strength and number of pass-by events. The noise levels esitmated for the groups of distributed sources of the same type were used to determine property line noise levels for the impact analysis. The designations of source operation areas were based on the examination of location of specific operations and activities within each railyard type as far as possible, as previously discussed in Section 3.

Another basic concept for the noise model was the grouping of railyards by two types, hump and flat yards, and three main functions: classification, industrial and small industrial yards. The classification yards are further separated into low, medium and high traffic categories, based on the number of railcars classified per day. Thus, there are eight typical yards in the composite model:

- High Traffic or Activity Hump Classification Yards
- Medium Traffic Hump Classification Yards
- Low Traffic Hump Classification Yards
- High Traffic Flat Classification Yards

- Medium Traffic Flat Classification Yards
- Low Traffic Flat Classification Yards
- Industrial Flat Yards
- Small Industrial Flat Yards

The basis for these groupings, and the supporting data on the number of yards and their distribution by location (place size) and traffic level, were developed in a railroad yard survey conducted for DOT.[4] (See Section 3.) Therefore, the noise generation model is thus based on the average noise level, average number of sources and average activity level data for each of the classes of yards which are either presented in the referenced document or derived from the statistical data therein. The model was developed on the basis of average or statistically expected values used in a deterministic procedure (as opposed to a stochastic model) to make relative comparisons.

In view of the diversity and scope of details regarding railyards and their operations, the severe limitations of the available data and the time constraints imposed by the Federal Court ordered schedule for the development of the regulation, the railyard noise impact model was intended only to provide a consistent procedure for estimating the magnitude of impact on a national scale, and a basis for relative comparisons between an estimate of baseline impact and changes in impact as selected noise reduction options were considered. It was not possible, and there was no intent, to use the model for providing absolute accuracy of noise impact determinations, either for an individual yard, or for the total number of railyards. Additionally, the numbers of variables and assumptions required by the model made it impractical to conduct a composite uncertainty analysis to set bounds on the magnitude of impact with known confidence levels. Finally, there were no explicit legal requirements directing the Agency to base the noise regulation on benefits (reductions in noise impact).

A schematic diagram of the railroad yard noise adverse response impact model outlining the basic elements of the model and the required input information is shown in Figure 5-3. The railyard noise sources are listed in Table 5-2 and Figure 5-2, and the representative or average noise level for each of the sources are discussed in Section 4 and listed in Table 4-1 and Table 5-4.

Average Noise Source Levels

The railyard noise data base provided average (energy basis) noise levels (L_{ave})* at a distance of 30 meters from the source for each of the major noise sources identified. In the case of such time-varying noise levels as retarder, car impact and locomotive pass-by the averages of the maximum A-weighted sound levels, L_{ave} max were computed. In addition, for moving sources and intermittent sources a sound exposure level (L_s) was determined from L_{ave} values and the corresponding event duration (or time-history). The L_{ave} and L_s values were calculated according to:

$$L_{ave} = 10 \log \frac{1}{n} \sum_{i=1}^{n} 10^{L_i/10}$$

$$L_s = L_{ave} \text{ max} + 10 \log \left(\pi \frac{D}{V}\right), \quad \text{for moving sources (Ref. 5);}$$

$$L_s = L_{ave} \text{ max} + 10 \log t_{eff}, \text{ for stationary sources}$$

where:

L_i = Measured A-weighted sound level for specific event i, dB

n = Number of measurements for each source

L_{ave} = Average or average maximum A-weighted sound level, dB

D = Shortest distance between stationary observer and source path

V = Source speed

T_{eff} = Effective duration, seconds.

The results are shown in Table 5-4, which provides necessary input data for the noise impact model.[2,6,7,8,9,10,11,12,13]

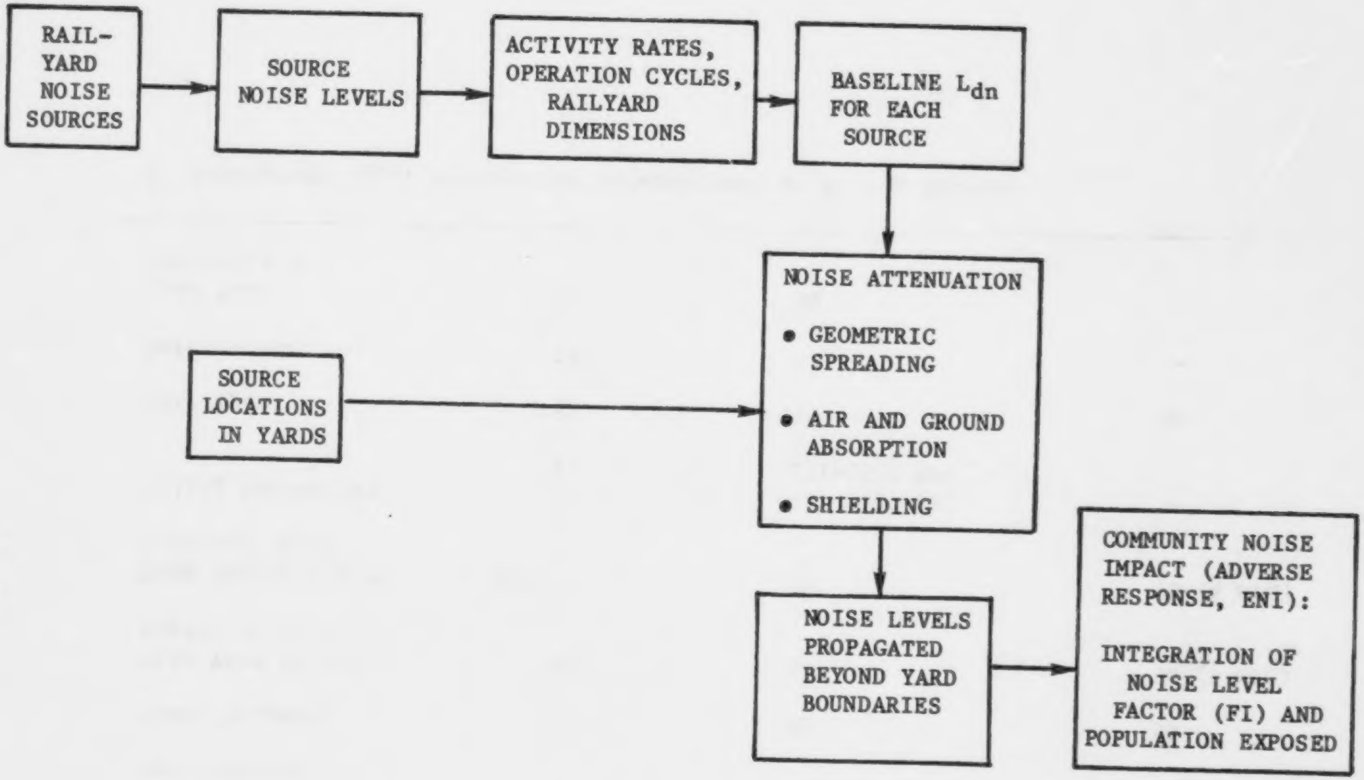

RAIL-YARD NOISE SOURCES
SOURCE NOISE LEVELS
ACTIVITY RATES, OPERATION CYCLES, RAILYARD DIMENSIONS
BASELINE L_{dn} FOR EACH SOURCE
SOURCE LOCATIONS IN YARDS
NOISE ATTENUATION
• GEOMETRIC SPREADING
• AIR AND GROUND ABSORPTION
• SHIELDING
NOISE LEVELS PROPAGATED BEYOND YARD BOUNDARIES
COMMUNITY NOISE IMPACT (ADVERSE RESPONSE, ENI):
INTEGRATION OF NOISE LEVEL FACTOR (FI) AND POPULATION EXPOSED

FIGURE 5-3. RAILROAD YARD NOISE IMPACT MODEL

Table 5-4

SOURCE NOISE LEVEL SUMMARY

Noise Source	Number of Measurements	Level of Energy Average* $L_{Ave.}$ @ 30 m, dB	L_s @ 30 m
Master Retarder: Group, Track, and Intermediate	410	111	108
Inert Retarder	96	93	90
Flat Yard Switch Engine Accelerating	30	83	98 (5 MPH)
Hump Switch Engine, Constant Speed	Ref. 6	78	95 (4 MPH)
Idling Locomotive	27 55	65(<2500 HP) 67(>2500 HP)	-
Car Impact	164	99	94
Refrigerator Car	23	67	-
Load Test (Throttle 8)	59	90	-

* A-weighted L_{max}, Average for Intermittent or Moving Sources

The flat yard switch engine noise level represents the noise level for an acceleration condition associated with "kicking" (decoupling) cars, and pulling out a cut or block of cars. The hump switch engine noise level represents a condition of constant velocity for hump switching and other switch engine operations at a steady pull. The integration of the noise level time histories for retarder and car impact noise events given in the data base indicate average effective durations of 1/2 and 1/7 seconds, respectively. Additional discussion of the noise source level data base and determination of expected average levels for selected source types is provided in Appendix L.

Noise Generation Models

The noise rating scale selected to assess railyard noise impact is the day-night sound level, L_{dn}. Since the railyard noise model is developed from measured sound levels for each individual source, a baseline L_{dn} value is required for each source and for each level of activity. The empirical data base on railyard source noise levels in general provided average A-weighted sound levels (L_{ave}) and single-event noise exposure levels (L_s) as discussed in the previous section. It is necessary, then, to use the L_{ave} or L_s values and the activity parameters to compute the baseline L_{dn} values. The expressions for L_{dn} will vary depending on the type of source, and mode of operation. The two general expressions used for L_{dn} at a given location are:

$$L_{dn} = L_s + 10 \log (N_d + 10N_n) - 49.4, \text{ and}$$

$$L_{dn} = L_{eq(1)} + 10 \log (N_d + 10N_n) - 13.8,$$

where

N_d = number of daytime events (or occurrences)

N_n = number of nighttime events

$L_{eq(1)}$ = the equivalent or average sound level for 1-hour periods

N_d = number of hours operating during the daytime

N_n = number of hours operating during nighttime.

The daytime and nighttime periods, are defined as 7 A.M. to 10 P.M. and 10 P.M. to 7 A.M., respectively. The two L_{dn} expressions above are used with the baseline noise data to compute L_{dn} values at 30 meters from the source. The latter of the two expressions is applicable when $L_{eq}(1)$ remains the same for all hours the source is operated. This condition was determined to hold for parked refrigerator cars, stationary idling locomotives and locomotive load tests. The first expression for L_{dn} is applicable to moving sources such as the switch engines, and to intermittent sources such as car impacts and retarder noises.

A more detailed discussion of the distribution of sources in the rail yards and the methods and assumptions used to develop activity parameters is presented in Appendix N.

RAILYARD NOISE IMPACT

Railyard Boundary Noise Levels

The baseline L_{dn} values for the railyard noise sources were determined from: 1) average source noise levels at a reference distance of 30 meters, 2) railyard source activity and operational parameters and 3) average attenuation factors for each noise source or group. These three parameters were used to compute railyard boundary noise levels which formed the basic input data base for the railyard impact model. The general expression for computing L_{dn} values will be discussed in the following subsections.

Analysis of the EPIC survey data indicated that hump and flat classification railyards have an asymmetrical configuration. As a result, a near and a far yard boundary distance was assigned to each yard source and an L_{dn} value was determined for each boundary distance. The generalized configurations and dimensions for each railyard type are shown in Figures 5-3, 3-8 and 3-9. A summary listing of the input data base L_{dn} values as a function of distance to the near and far side of the yard boundary is presented in Tables 5-5 through 5-8.

Table 5-5

HUMP YARD NOISE SOURCE AVERAGE DAY-NIGHT SOUND LEVEL (L_{dn}) AS A FUNCTION OF DISTANCES (d_n&d_f) TO NEAR AND FAR SIDE OF YARD BOUNDARY AND TRAFFIC RATE CATEGORY

		L_{dn} (dB) FOR TRAFFIC RATE CATEGORY					
		LOW		MEDIUM		HIGH	
Source Location*	Noise Source	Near Side	Far Side	Near Side	Far Side	Near Side	Far Side
(a)		@ 42 m	@137 m	@ 43 m	@146 m	@ 55 m	@171 m
	Hump Switchers	65	60	68	63	69	64
	Inbound Trains	64	58	67	61	68	62
(b)		@ 64 m	@192 m	@ 95 m	@192 m	@113 m	@229 m
	Retarders (Master and Group)	86	72	85	75	87	76
	Idling Locomotives	71	61	71	65	69	60
	Load Tests	—	—	--	--	75	69
(c)		@ 64 m	@192 m	@ 95 m	@192 m	@113 m	@229 m
	Inert Retarders	68	54	67	57	69	58
	Refrigeration Cars	70	59	73	66	73	66
	Car Impacts**	67	55	66	59	66	58
(d)		@ 43 m	@137 m	@ 43 m	@146 m	@ 55 m	@171 m
	Makeup Switchers	68	62	71	65	71	65
	Industrial Switchers	69	63	68	62	72	66
	Outbound Trains	65	59	68	62	69	63

* Refer to Fig. 5.3

** There are two car impact groups, each group represented by an equivalent stationary source with the same levels as shown.

Table 5-6

FLAT CLASSIFICATION YARD NOISE SOURCE AVERAGE DAY-NIGHT SOUND LEVEL (L_{dn}) AS A FUNCTION OF DISTANCES (d_n&d_f) TO NEAR AND FAR SIDE OF YARD BOUNDARY AND TRAFFIC RATE CATEGORY

		L_{dn} (dB) FOR TRAFFIC RATE CATEGORY					
		LOW		MEDIUM		HIGH	
Source Location*	Noise Source	Near Side	Far Side	Near Side	Far Side	Near Side	Far Side
(a)		@ 30 m	@107 m	@ 30 m	@137 m	@ 91 m	@183 m
	Classification Switchers (W)	69	64	74	67	71	67
	Inbound Trains	60	55	63	56	60	57
(b)		@ 34 m	@107 m	@ 34 m	@128 m	@ 91 m	@213 m
	Idling Locomotives	78	68	81	70	73	66
	Load Tests	--	--	--	--	78	70
(c)		@ 34 m	@107 m	@ 34 m	@128 m	@ 91 m	@213 m
	Refrigeration Cars	79	69	81	70	75	67
	Car Impacts**	69	58	73	61	66	56
(d)		@ 30 m	@107 m	@ 30 m	@137 m	@ 91 m	@183 m
	Classification Switchers (E)	69	64	74	67	71	67
	Outbound Trains	64	59	67	60	63	60

* Refer to Fig. 5.3

** There are two car impact groups, each group represented by an equivalent stationary source with the same levels as shown.

Table 5-7

FLAT INDUSTRIAL YARD NOISE SOURCE AVERAGE DAY-NIGHT SOUND LEVEL (L_{dn}) AS A FUNCTION OF DISTANCES (d_n&d_f) TO NEAR AND FAR SIDE OF YARD BOUNDARY

	L_{dn} (dB) For	
Noise Source	Near Side	Far Side
	@ 70 m	@ 70 m
Inbound Trains	53	53
Outbound Trains	53	53
Switch Engines	69	69
Car Impacts	65	65

Table 5-8

SMALL FLAT INDUSTRIAL YARD NOISE SOURCE AVERAGE DAY-NIGHT SOUND LEVEL (L_{dn}) AS A FUNCTION OF DISTANCES (d_n&d_f) TO NEAR AND FAR SIDE OF YARD BOUNDARY AND TRAFFIC RATE CATEGORY

	L_{dn} (dB) For	
Noise Source	Near Side	Far Side
	@ 52 m	@ 52 m
Inbound Trains	54	54
Outbound Trains	54	54
Switch Engines	64	64
Car Impacts	61	61

Noise Impact Model for Railyards

The impact analysis methodology requires the determination of the variation of L_{dn} with distance from the railyard boundary. The basic general expression for computing L_{dn} values for each source or source group at any distance (D) from the source is:

$$L_{dn} = L_{dno} - 10 \log \left(\frac{D}{D_o}\right)^n - (k_1 + k_2)(D - D_o)$$

L_{dno} = baseline L_{dn} value at D_o (the yard boundary), dB

D_o = distance from source to yard boundary, m

n = 1 for moving sources

n = 2 for stationary sources

k_1 = combined air and ground absorption coefficient, dB/m

k_2 = building insertion loss coefficient, dB/m

The baseline L_{dn} values are listed in Tables 5-5 to 5-8. The air and ground absorption coefficient and the building insertion loss coefficient (k_2) values were determined as a function of noise source expected distribution, and place size and average population density (ρ), respectively. The evaluation and development of these coefficients are discussed in Appendix Tables N-7 and N-8 of Appendix N.

The basic noise impact relationship is given by ENI = FIxAxρ where the area (A) is a function of source type, either moving or stationary, and population density (ρ) is a function of place size and population density range. The general equations for computing A were developed on the basis of eliminating the area inside the yard boundary from the determination of noise impact areas. The area expressions for the two different types of sources are for either segments of circles for stationary sources or rectangular strips for moving sources:

$$\frac{A}{2} = L_o D / D_o \text{, for moving sources}$$

$$\frac{A}{2} = D^2 \cos^{-1}(D_o/D) - D_o \sqrt{D^2 - D_o^2} \text{ , for stationary sources}$$

where:

L_o = characteristic path length for moving sources

D = distance from source to receiving location

D_o = distance from source to railyard boundary

The density values applicable to the railyard areas in terms of place size and population density range are presented in Appendix M, Table M-3.

The characteristic path length for the switch engines and locomotives were determined on the basis of the 120 yard sample evaluated during the EPIC survey as previously discussed. The resulting L_o values ranged from 790 to 2070 meters, depending on type of yard and traffic rate (see Figures 3-8 and 3-9).

The railyard noise model was developed to determine the noise impact resulting from individual noise sources. The yard noise sources are modeled as either moving sources or as stationary sources. As a result of uncertainties in the treatment of the interaction of railyard noise sources with external (to the railyard) ambient sources, the modeling of this interaction was approached in two independent ways. In one case, the noise emanating from each source is propagated out to the distance where the L_{dn} value is decreased to either the 56 to 55 dB range, or to 1 dB above the estimated local ambient noise level. The background (or ambient) noise level, due to other than railyard noise sources, is determined from the site specific local average density values (see Table M-3, Appendix M) for each place size and density range class according to the formula: [14]

Background Noise Level = $22 + 10 \log \rho$, ρ = people/sq mi.

In the second case, wherever the background noise level, as determined by the above equation, is equal to or greater than $L_{dn} = 55$ dB, it is assumed that, as a result of other EPA noise source regulations and additional noise abatement measures undertaken by state and local communities, external ambient noise levels would be reduced to $L_{dn} = 54$ dB. The model was exercised to determine the sensitivity of the results to these differing assumptions. The noise attenuation as a function of distance depends on the type of source, the spectral distribution of noise energy and the population density, as discussed in previous sections. The impact of each yard noise source, given in terms of Equivalent Noise Impact (ENI), is obtained by summing the noise source impacts over the appropriate number of yards defined by yard type, function and activity level, and place size population density.

To determine yard noise impact, compute the ENI for each source for each yard category according to the following sequence:

- Select yard type, traffic rate, place size and source.
- Find L_{dno} from yard/source matrix.
- Compute L_{dn} per D for each 1 dB interval using appropriate n, k_1 and k_2 values relative to source and population density range.
- Compute FI for each successive strip area using the L_{dn} average relative to the strip boundaries.
- Compute strip area (A_i) between successive D values (in accordance with the type of source). Continue out to boundary of noise impact area.
- Compute ENI_i for each strip area using the appropriate population density value for the place size
- Sum the ENI_i values to obtain the ENI per each density range for the selected conditions. Multiply the ENI value by the number of railyards in the particular yard category selected.
- Repeat the procedure and sum the ENI values for all the sources, all the population density ranges, all the place size classes and all the railyards for the selected yard type and activity level.
- Repeat the procedure for each activity level to obtain total ENI for all the yard types selected.
- Repeat the procedure for each of the yard types and obtain the grand total ENI for all sources, yard types, activity levels, etc.

A flow diagram for the model elements and ENI computing procedure is shown in Figure 5-4. A computerized model for the railyard noise impact assessment, programmed according to the above relationships, was exercised

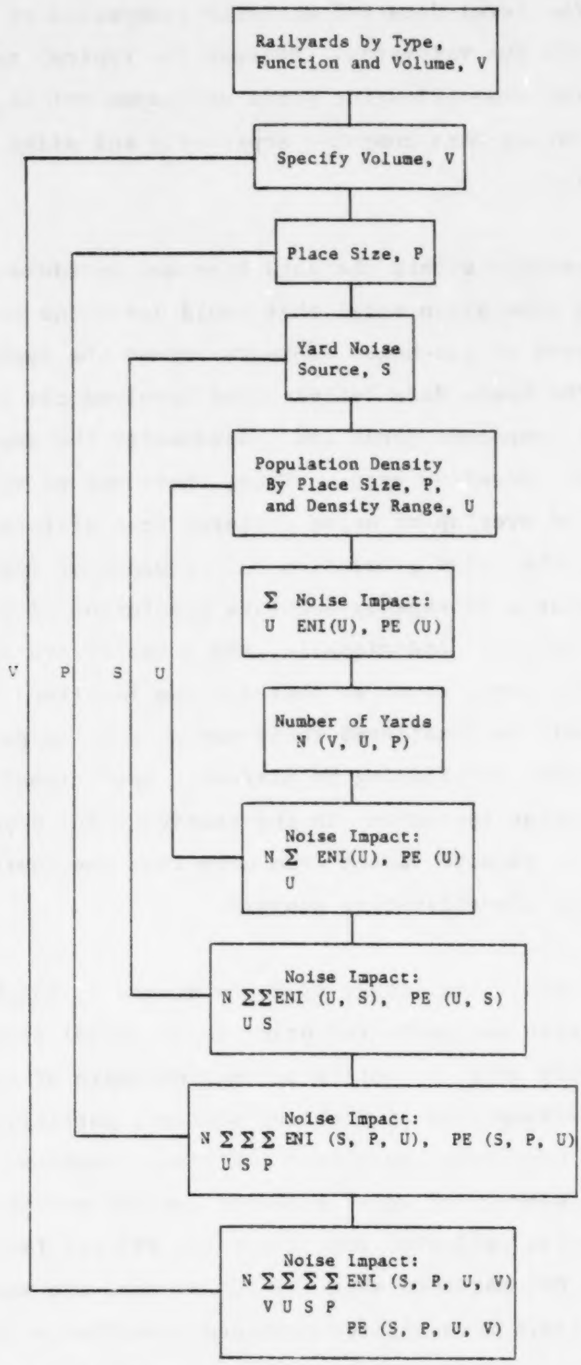

Railyards by Type, Function and Volume, V
Specify Volume, V
Place Size, P
Yard Noise Source, S
Population Density By Place Size, P, and Density Range, U
Σ Noise Impact: U ENI(U), PE (U)
Number of Yards N (V, U, P)
Noise Impact: N Σ ENI(U), PE (U) U
Noise Impact: N ΣΣ ENI (U, S), PE (U, S) U S
Noise Impact: N ΣΣΣ ENI (S, P, U), PE (S, P, U) U S P
Noise Impact: N ΣΣΣΣ ENI (S, P, U, V) V U S P PE (S, P, U, V)
V
P
S
U

FIGURE 5-4. RAILYARD NOISE IMPACT MODEL

using baseline noise level data and activity parameters to obtain the total baseline ENI for all the railyards. Because the typical configuration of the hump and flat classification yards was asymmetrical, the near side and far side ENI values were computed separately and added to obtain the total baseline ENI.

It was not possible within the data base and schedule limitations to develop a railyard simulation model that would determine accurately the location and patterns of iso-noise contours around the typical yard configurations. One of the basic data deficiencies involved the locations of sources within the component yards and consequently the separation distances between sources and operation areas. Thus, there was no way to accurately assess the degree of overlap of noise patterns from different types of sources. However, the noise generation and propagation model for each type of source did provide a reasonably accurate prediction of the noise patterns for an individual source. Additionally, the total length of the railyards was generally sufficiently great so that for the idealized configuration used in the model it could be considered there was no overlap pattern between identical source types functioning in different operational areas of railyards, e.g., the switch engine operations in the receiving and departure yards. The areas more likely to receive impact from more than one source would be those near each end of the classification subyard.

A preliminary analytical study of a few simple or idealized cases of noise overlap patterns was conducted prior to the final development of the railyard noise impact model to obtain a rough estimate of the likely error range between the assumptions of combined sources, partially overlapped noise patterns and completely separated individual sources. This was done for two stationary sources of equal strength and two moving sources of equal strength. The results indicated that the total ENI for two completely separated sources equals the ENI obtained when the two sources are superimposed. The partial overlap pattern investigated produced less than a 20% error relative to no overlap. The error is not very large because in the partial overlap (or superposition) case, although there is a common area where the noise levels are greater than if only one of the sources were operating, the total area of exposure appears to be reduced compared to two completely separated sources. Thus there are two opposing effects which tend to minimize the relative error.

The impact model was developed on the basis of individual source noise propagation patterns and included no procedure either to account for proximity of sources or to estimate joint impact from more than one source. Thus the impact (in terms of ENI) values for each source are computed separately, and the aggregate impact for each yard type and the grand total from all yards is obtained by summing over the sources.

Several versions of the total impact model were developed for the case of one yard type to provide a comparison between results for individual versus grouped sources. The results of a comparison of 11 separate and independent sources with 4 groups of superimposed sources derived from the 11 sources indicate that the impact (ENI) values were about 18 percent greater for the separated source case.

Baseline Impact

A model run using data based on the estimated current conditions for the identified sources at all the railyards was considered the baseline case. The estimated total Equivalent Noise Impact (ENI) ranges from 1,740,600 to 1,945,500 depending upon the method for handling the external ambient. The smaller value is associated with the case in which the ambient noise level is reset to 54 dB in areas where the population density equation yields values that equal or exceed 55 dB. Similarly, the corresponding population exposed (PE) to railyard noise ranges from 6,509,600 to 10,182,000. In this situation, the higher value of population exposed is associated with the case in which the ambient noise level is reset to L_{dn} = 54 dB. (The Population Exposed value is the number of people exposed above L_{dn} = 55 dB. This value contains no weighting for the severity of impact, as does ENI.) The baseline ENI and PE results are segregated in Table 5-9 which presents the computed ENI and PE values for each source type, aggregated yard type, volume and by place size. The resulting sensitivity to the assumptions regarding the treatment of external ambient

Table 5-9

BASELINE CASE
CONTRIBUTION TO TOTAL ENI AND PE FOR ALL YARD TYPES BY TYPE OF SOURCE

Source Type	ENI	PE
Inbound and Outbound Trains	201,180 - 214,200	1,082,100 - 2,311,500
Switcher Operations	1,243,300 - 1,400,100	4,274,800 - 5,957,000
Idling Locomotives	88,580 - 98,900	346,600 - 561,900
Retarders (Master, Group, Inert)	26,720 - 28,900	65,700 - 98,830
Refrigerator Cars	92,110 - 102,700	342,700 - 545,200
Car Impacts	50,400 - 55,400	256,500 - 509,920
Load Test Operations	39,930 - 44,300	141,200 - 208,900
	1,740,600 - 1,944,500	6,509,600 - 10,182,000

Ranges of values are due to different methods for handling the external ambient noise level. Any inconsistencies in numerical values are attributable to round off. See text for further explanation.

noise levels yields a 56.4 percent difference in baseline population exposed, and a 10.5 percent difference in baseline ENI. Because of the large difference in population exposed resulting from the two assumptions, the following Tables 5-10 through 5-12 are presented utilizing the case which yields the smaller of the population exposed values, although the ENI values are slightly larger. It is noted that additional sensitivity analyses indicated that the RCI values presented later in Table 5-12 are almost identical for the two cases. Therefore, even though the baseline noise impact measured may be sensitive (to differing degrees) to the assumptions regarding external ambient, the benefits resulting from varying regulatory options are much less sensitive on a percent reduction basis. The dominant contributors to the noise impact are switch engines since these sources operate in all 4169 yards and generally outnumber each of the other source types. A more detailed listing of noise impact (ENI) by noise source and yard type is presented in Table 5-10. The results indicate that the flat classification yards account for about one-half the total impact, since they both account for a much greater number of yards than do hump yards and operate at a much higher activity rate with a greater number of noise sources than the industrial yards. Note also that, whereas hump yards comprise less than 3 percent of railyards in the U.S., their equivalent noise impact is about 14 percent of the total ENI. Flat classification yards constitute about 27 percent of U.S. railyards, but account for about 49 percent of the total ENI. Thus, while the classification type yards comprise only 30 percent of the total railyards, they account for the major portion (63 percent) of the impact. The disproportionate impact of the classification yards relative to all the other railyards is mainly due to the large number of noise sources and higher traffic rates (with consequent higher noise exposures) at classification yards.

Study Options Impact

A number of noise reduction options (or treatments) for four dominant noise sources in railyards are discussed in Section 4. The benefits attributable to the various proposed treatments were examined by determining the reductions in L_{dn} resulting at the railyard boundaries from the application of the proposed treatments or options, and using the noise impact model with the

Table 5-10
BASELINE CASE

CONTRIBUTION TO TOTAL ENI BY TYPE OF SOURCE AND TYPE OF YARD

Yard Type (No. of Yards)	Source Type	ENI	% ENI for Yard Type	% of Total ENI all Yards
Hump: (124)	Inbound and Outbound Trains	65,200	23.8	3.5
	Switchers (Hump, Industrial, Make-up)	154,100	66.2	8
	Idling Locomotives	7,000	2.6	
	Master Retarder Group	27,000	9.8	
	Inert Retarder Group	1,900	0.7	
	Refrigerator Cars	8,900	3.2	
	Car Impacts	4,200	1.5	
	Load Tests	5,900	2.2	
	Subtotal	274,200	100	14
Flat Classification: (1113)	Inbound and Outbound Trains	126,700	13.4	6.5
	Switchers	564,000	59.9	29
	Idling Locomotives	91,900	9.8	
	Refrigerator Cars	93,800	10.0	
	Car Impacts	27,400	2.9	
	Load Tests	38,400	4.1	
	Subtotal	942,200	100	48.5
Industrial and Small Industrial (2932)	Inbound and Outbound Trains	22,300	3.1	
	Switchers	682,000	93.7	35
	Car Impacts	23,800	3.2	
	Subtotal	728,100	100	37.5
	TOTAL	1,944,500		

Table 5-11

SOURCE TREATMENT OPTIONS AND NOISE LEVEL REDUCTIONS

Source	Option (*)	Noise Reduction Treatment
Retarders (Hump Yards)	1 (T_1)	Noise barrier walls 8 ft (2.5 m) high by 1500 ft (457 m) long are placed along the yard boundaries (both sides) at the hump-switch end of the classification area. The expected noise level reductions in the receiving property area are 10 dB and 8 dB, respectively, at the near and far sides relative to the master retarder location. These reductions are averages for the consideration of distributed group retarders (i.e., some nearer and some farther from the walls) and receiving property locations 50 ft (15.2 m) to 200 ft (61 m) beyond the walls.
	2 (T_2)	Noise barrier walls 15 ft (4.6 m) x 1500 ft (457 m). on the near side and 10 ft (3 m) x 1500 ft (457 m) on the far side, with same considerations as Option 1 above. Expected average noise level reductions in the receiving property area are 15 dB and 13 dB.
	3 (T_3)	Same as Option 2 above, with the addition of 12 ft (3.7 m) x 150 ft (45.8 m) absorptive noise barriers along both sides of the master retarder(s). This increases the expected noise level reductions in the receiving property areas (within 200 ft (61 m) of the walls) to 18 dB and 15 dB, respectively, for the near and far sides.
Load Cells	1 (T_4)	Load cells are assumed to be located in high volume yards (hump and flat classification) only. Absorptive noise barriers 20 ft (6.1 m) x 150 ft (45.8 m) are placed along both sides of the load test cell and locomotive position. The expected noise reduction in the receiving property area is 13 dB.
	2 (T_5)	Absorptive noise barriers 25 ft (7.6 m) x 150 ft (45.8 m) are placed at the load cell. Expected noise reduction is 15 dB.

Table 5-11

SOURCE TREATMENT OPTIONS AND NOISE LEVEL REDUCTIONS (continued)

Source	Option (*)	Noise Reduction Treatment
Switch Engines	1 (T_6)	Minimum expected noise reductions for switch engines per AAR data - Throttle 0 : 0 dB Throttle 1 to 2: 1 dB Throttle 3+ : 3 dB Noise impact model assumes a mix of 50% switch engines and 50% road haul locomotives conducting yard operations. The composite noise reductions assumed are (treated switchers, untreated locomotives) - Throttle 0 : 0 dB Throttle 1 to 2: 1 dB Throttle 3+ : 2 dB
	2	Maximum expected noise reductions for switch engines - Throttle 0 : 3 dB Throttle 1+ : 4 dB For 50/50 mix switch and road haul engines, the assumed composite level reductions are - Throttle 0 : 1 dB Throttle 1+ : 3 dB
Car Coupling	1 (T_7)	A coupling speed limit of 4 MPH is assumed. The expected baseline (no speed limit) energy average level is determined by integration of the product of the speed-probability distribution (Ref. 10) and the energy average noise level vs. speed functions (derived from Ref. 11). Then, the speed-probability distribution is skewed by assuming all coupling events above 4 MPH are in the 3 to 4 MPH range, and a new expected average coupling noise level is computed. The resulting expected noise level reductions are - Max Level: 7 dB SEL : 8 dB
	2 (T_8)	A coupling speed limit of 6 MPH is assumed. The new skewed distribution average level is determined similarly as in Option 1 above, and compared to the baseline exp. level. The expected noise level reductions are - Max. Level: 2 dB SEL : 2 dB

Table 5-11

SOURCE TREATMENT OPTIONS AND NOISE LEVEL REDUCTIONS (continued)

Source	Option (*)	Noise Reduction Treatment
Car Coupling	3	Same as Option 2 above, but any noise level is allowable for measured coupling speeds $\leq$ 6 MPH. Relative to the baseline expected level, the noise level reduction assumed is 1 dB.
	4 (T_9)	A coupling speed limit of 8 mph is assumed. The new skewed distribution average level is determined as in Option 2 above, and compared to the baseline expected level. The expected noise level reductions are - Max. Level: 0-1 dB** SEL : 0-1 dB
	5	Same as Option 4 above, but any noise level is allowable for measured coupling speeds $\leq$ 8 mph. Relative to the baseline expected level, the noise level reduction is 0-1 dB**.

---

* Treatment number per Section 4. Note that the noise reductions shown in this table are in terms of reductions in L_{dn} (a measure of the change of cummlative noise exposure) rather than reductions in L_{max} for an individual event. These noise reductions were developed from expected decreases in source L_{max} (for example, barrier insertion loss for retarders) as discussed in Section 4, and other considerations. These other considerations included the effects on composite cummulative noise exposure levels from groups of like sources (master and group retarders), and the effects on noise barrier lengths, the spatial distribution of like sources in a group and the relative mix of source sizes (such as road haul locomotives and switch engines).

** Limited data relative to noise data vs. speed causes uncertainties in computational accuracy in these cases.

Table 5-12

BENEFITS (IMPACT REDUCTIONS) FOR SOURCE NOISE REDUCTION OPTIONS

Noise Source	Noise Reductions Option (*)	Noise Impact Reduction for All Yards			Residential Land Use		Residential and Commercial Land Use****	
		(ΔENI)	%RCI$_1$**	%RCI$_2$***	ΔENI	% RCI***	ΔENI	% RCI***
Master and Group Retarders:	1 (T$_1$)	18,400	63.7	1.0	16,173	0.8	16173-18400	0.8-1.1
	2 (T$_2$)	23,200	80.3	1.2	20,395	1.0	20395-23200	1.0-1.2
	3 (T$_3$)	24,600	85.1	1.3	21,623	1.1	21623-24600	1.1-1.3
Load Test Cells:	1 (T$_4$)	40,050	90.4	2.05	39,650	2.03	39650-40050	2.03-2.05
	2 (T$_5$)	42,500	95.9	2.18	42,075	2.16	42075-42500	2.16-2.18
Switch Engine Operations:	1 (T$_6$)	199,460	14.2	10.2	167,456	8.6	167456-199460	8.6-10.2
	2	551,500	39.4	28.3	463,260	23.8	463260-551500	23.8-28.3
Car Coupling:	1 (T$_7$)	50,100	90.4	2.6	40,581	2.1	40581-50100	2.1-2.6
	2 (T$_8$)	21,600	39.0	1.1	17,496	0.9	17496-21600	0.9-1.1
	3	15,900	28.7	0.8	12,879	0.7	12879-15900	0.7-0.8
	4 (T$_9$)	15,900	28.7	0.8	12,879	0.7	12879-15900	0.7-0.8
	5	7,950	14.4	0.4	6,440	0.3	6440-7950	0.3-0.4

---

*Treatment Number per Section 4

**% Relative Change in Impact, $RCI_1 = \frac{\Delta ENI}{\text{Baseline ENI for source}} \times 100$

***$\%RCI_2 = \frac{\Delta ENI}{\text{Total Baseline ENI for all sources and all yards}} \times 100$

****The increases in ΔENI and %RCI for "Residential and Commercial Land Use" are actually additional residential benefits gained from protection of commercial property. Benefits to people while on reduced levels to estimate new ENI and PE values. A summary of the corresponding noise reduction options and the magnitude of expected noise level reductions are listed in Table 5-11. A summary of the results in terms of ENI and relative change in impact (RCI)* is presented in Table 5-12. In the case of the first ΔENI column, it was assumed that the noise reduction option was applicable to all the railyards operating that particular source, regardless of the average distribution of land use around the yard type or group. In the last column under "Residential and Commerical Land Uses", the ΔENI and % RCI benefit ranges shown indicate additional residential benefits gained from the protection of commercial properties.

While benefits to people using commercial land have not been quantified, the activities conducted in these areas (shops, services, offices, parks, places of public assembly, etc.) are especially sensitive to noise intrusion. In most cases, the utility of the property is dependent on effective speech communication. Some "commercial" land uses, such as parks and resort areas, require a level of quiet conducive to rest and relaxation. Thus, benefits of protecting commercial areas from excessive noise are not reflected in Table 5-12.

The noise impact reductions for retarders and locomotive load test cells were relatively small due to the small portion of the total railyards involved, and since the total number of load cells was also relatively small. The reduction in car coupling noise impact was small since the 6 MPH speed limit results in only a small noise level reduction and the baseline ENI for this source was only a small fraction of the total (see Table 5-9).

However, switch engine operations are extensive in all the yards and constitute the major portion of the total impact so that even a small source noise level reduction results in relatively large benefits (ENI reductions).

---

* $$\text{RCI} = \frac{\text{Baseline ENI - Noise Reduction Option ENI}}{\text{Total Baseline ENI}} \times 100$$

where the ΔENI (numerator) is only for the noise source being treated, while the total ENI (demominator) is the sum for all sources and all railyards.

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SECTION 6

ANALYSIS OF COST AND ECONOMIC IMPACT

INTRODUCTION

This section describes the increased capital and operating and maintenance costs and derivative economic impacts associated with alternative regulatory options for each of the following railyard noise sources:

- Active Retarders
- Locomotive Load Cell Test Stands
- Car Coupling
- Switcher Locomotives

The costs and economic impacts are analyzed at both the aggregate industry level and also for individual rail carriers. The costs and economic impacts are based upon data presented in Sections 2 through 4 concerning industry baseline data, railyard configurations and noise abatement technology.

Methodology

A simplified flow diagram of the procedures used to evaluate the compliance costs and associated macro and micro economic impacts upon consumers and the railroad industry is given in Figure 6-1. The methodology consists of the following analytical steps:

- Develop baseline industry data to include:
    - Number of yards owned by each road
    - Number of yards surrounded by residential and commercial receiving land uses
    - Number of each noise source existing in each yard
    - Employment
    - Output
    - Costs

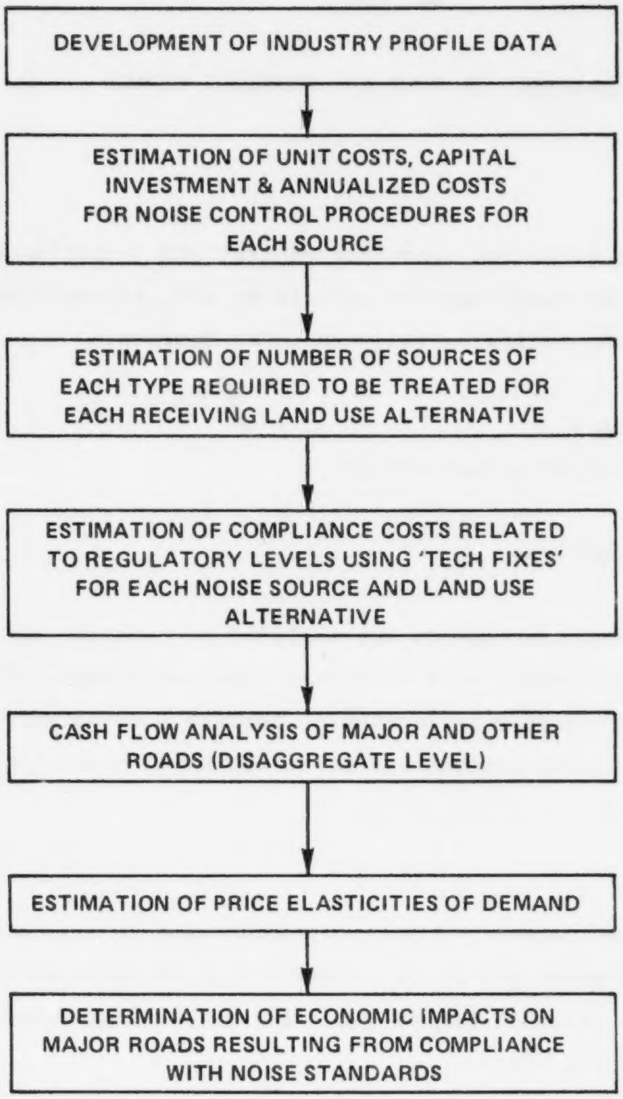
DEVELOPMENT OF INDUSTRY PROFILE DATA
ESTIMATION OF UNIT COSTS, CAPITAL INVESTMENT & ANNUALIZED COSTS FOR NOISE CONTROL PROCEDURES FOR EACH SOURCE
ESTIMATION OF NUMBER OF SOURCES OF EACH TYPE REQUIRED TO BE TREATED FOR EACH RECEIVING LAND USE ALTERNATIVE
ESTIMATION OF COMPLIANCE COSTS RELATED TO REGULATORY LEVELS USING 'TECH FIXES' FOR EACH NOISE SOURCE AND LAND USE ALTERNATIVE
CASH FLOW ANALYSIS OF MAJOR AND OTHER ROADS (DISAGGREGATE LEVEL)
ESTIMATION OF PRICE ELASTICITIES OF DEMAND
DETERMINATION OF ECONOMIC IMPACTS ON MAJOR ROADS RESULTING FROM COMPLIANCE WITH NOISE STANDARDS

FIGURE 6–1. FLOW DIAGRAM OF ANALYTICAL STEPS ENCOMPASSING COST & ECONOMIC IMPACT ANALYSIS

  - Prices/Revenues
  - Rate of return on net investment and equity
- For each noise source estimate:
  - initial increased unit capital investment costs to meet alternative regulatory levels
  - Recurring capital costs and out-of-service costs required to replace initial abatement equipment and materials
  - annual operating and maintenance costs
- Determine the total number of sources of each type required to be treated for each receiving land use alternative
- Estimation of the total initial capital, annual operating and maintenance and recurring annualized costs for each regulatory option associated with each noise source
- Analyze cash flow for each regulatory option and land use alternative for major and other roads
- Estimate the price elasticities of demand for principal railroad commodities
- Determination of the economic impacts on each major road of the alternative regulatory options and land uses for each source singly and in combination including impact upon:
  - Operating costs
  - Prices
  - Output
  - Employment

Summary of Compliance Cost Results

Table 6-1 presents a summary of the estimated compliance costs associated with key selected regulatory options for each noise source. This table indicates that for the specific regulatory alternatives discussed in Section 4 for each noise source, the total initial capital costs range from $91 million to $110 million depending upon the land use alternative considered, whereas the uniform annualized total cost outlay* ranges from $20 million to $24 million. These costs are in constant 1979 dollars.

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*Uniform annualized cost outlay is defined below.

Table 6-1

SUMMARY OF COMPLIANCE COSTS FOR KEY SELECTED REGULATORY ALTERNATIVES

Source	Description of Proposed Technology Discussed in Section 4	A-weighted Regulatory Limit (dB) **	Anticipated Reduction in Max Noise Level (dB)	Initial Capital Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Uniform Annualized Total Cost Outlay ($ x 10^6)	
				RES. ONLY	RES.+ COMM	RES. ONLY	RES.+ COMM.	RES. ONLY	RES.+ COMM.
1. Active Retarders	Option 3	83	21	33.4	40.1	0.72	0.87	2.94	3.48
2. Switcher Locomotives	Option 1	70 (Idle). 90 (Moving) (a) 30 Meters	0 (idle) 2 (Moving)	42.6	54.6	4.97	6.38	13.45	17.24
3. Locomotive Load Cell Test Stand	Option 2	78 (a) 30 Meters	15	13.65	14.0	1.04	1.05	2.40	2.45
4. Car Coupling	Option 5	92	1	N/A	N/A	N/A	N/A	N/A	N/A
Sub Total				89.65	108.7	6.73	8.30	18.79	23.17
5.* Measurement and Record Keeping	-	-	-	1.0	1.0	1.1	1.35	.98	1.16
TOTAL				90.65	109.7	7.83	9.65	19.77	24.33

N/A Cost on a national basis is expected to be minimal relative to other noise source and abatement aspects of this rulemaking

* Measurement and record keeping costs are included although not explicitly required by the regulation. Consultants may be used alternatively but at costs expected to be higher than those included above.

** Noise limits are at receiving property unless otherwise specified.

Railyard Source Noise Abatement Cost Estimating Procedures

For each noise source included, this section describes the key steps used to develop the estimated costs for the noise abatement alternatives considered.

The procedure used for the development of source noise control cost estimates is summarized in the following sequential steps:

Step 1. Identify noise sources located in railyards.

Step 2. Identify for each source the percentage of yards which have residential or residential and commerical land use in the vicinity of that source.

Step 3. Identify alternative noise abatement procedures that can be applied to each source to achieve reduced noise levels at receiving property.

Step 4. For each source estimate the unit noise abatement costs required for each regulatory alternative.

Step 5. For each source determine the number of units required to be treated for each land use alternative to achieve selected noise levels at yard boundaries.

Step 6. Estimate the total costs incurred to achieve each regulatory alternative for each land use.

The source noise control approach (Steps 1 through 6) consists of the application of selected noise abatement procedures to specific types of sources. The specific noise abatement procedures considered for each source and the reduction in noise levels at yard property lines are displayed in Table 6-2. This information is also shown in Table 6-3 for the specific regulatory options considered for each source.

For each source discussed on subsequent pages, tables of estimated total costs are presented for each alternate abatement procedure. Cost elements include estimates for initial capital investment including hardware, equipment, installation and out-of-service costs. Additionally, annual operations and maintenance costs are included.

Table 6-2

Noise Sources and Sound Level Reductions

Noise Sources	Noise Control Techniques	Range of Reduction in A-Weighted Sound Level (dB)*
Retarders (Master)	Absorptive Barriers 150 ft x 12 ft (46 m x 3.7 m)	16-22
Retarder (Master or Group)	(a) Reflective Boundary Walls 1500 ft x 8 ft (457 m x 2.5 m)	9-11
	(b) Reflective Boundary Walls 1500 ft x 15 ft (457 m x 4.6 m) 1500 ft x 10 ft (457 m x 3 m)	16-21
Locomotive Load Cell Test Stands	(a) Absorptive Barriers 150 ft x 20 ft (46 m x 6.1 m)	12-14
	(b) Absorptive Barriers 150 ft x 25 ft (46 m x 7.6 m)	14-16
Switch Engine Noise	Exhaust Silencer	0-1 at idle 1-5 moving
Car Coupling	(a) Reduce coupling speeds to less than 4 mph	7-8
	(b) Reduce coupling speed to less than 6 mph	1-2
	(c) Reduce coupling speeds to less than 8 mph	0-1

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* Refer to footnote on Table 4-6.

Table 6-3

Summary of Source Noise Control Technology Options

Technology Option	Noise Source	Technology Description
	Retarders	
1		Barrier walls 8 ft x 1500 ft (2.5 m x 457 m) near side and 8 ft x 1500 ft (2.5 m x 457 m) far side
2		Barrier walls 15 ft x 1500 ft (4.6 m x 457 m) near side and 10 ft x 1500 ft (3 m x 457 m) far side
3		In addition to option 2, 12 ft x 150 ft (3.7 m x 46 m) absorptive barriers are placed around the master retarder
	Locomotive Load Cell Test Stands	
1		Absorptive barriers 20 ft x 150 ft (6.1 x 46 m) placed 25 ft (7.6 m) from track centerline
2		Absorptive barriers 25 ft x 150 ft (7.6 m x 46 m) placed 25 ft from track centerline
	Switch Engines	
1		Exhaust Silencer
	Car Coupling	
1		Reduce rail car coupling speeds to less than 4 mph
2		Reduce rail car coupling speeds to less than 6 mph
3		Reduce rail car coupling speeds to less than 8 mph

For each source, capital recovery costs are included based upon both the initial and replacement capital and installation costs, interest rates and useful lives of the abatement techniques that would be required to meet the alternative regulatory options.

The capital recovery cost is defined as:

$$\left| U + \frac{R}{(1 + i)^{T} - 1} \right| \times i \times N \qquad \text{where:} \qquad (1)$$

U = initial unit costs of noise abatement equipment (capital & installation)
R = replacement unit costs (capital & installation)
i = interest rate
T = useful life of noise abatement technology
N = number of units required.

Also, an annualized cost is included which represents the sum of the capital recovery cost and the annual operating and maintenance costs.

In addition, a uniform annualized total cost outlay column is presented which accounts for: (1) the lead time prior to the imposition of a standard; (2) the fact that noise abatement investments may be financed for periods less than their useful lives and (3) that outlays may be in the form of uniform annuity type payments. The uniform annualized total cost outlay is defined as follows:

$$\frac{1}{\sum_{j=1}^{M} \frac{1}{(1+i)^{j-1}}} \left[\sum_{j=1}^{M} C_j \frac{1}{(1+i)^{j-1}} \right] \qquad \text{where:} \qquad (2)$$

C = yearly cost
i = interest rate
M = number of years in time string

INDIVIDUAL NOISE SOURCE COST ESTIMATES

Retarders

Introduction

The agency originally proposed a 90 dB source standard for active retarders to be measured at 30 meters. To meet this standard it was anticipated that 12 foot x 150 foot (3.6 m x 46 m) absorptive barriers would be required to be placed near each master and group retarder at an estimated total cost of $14 million dollars.

The agency assumed that no operational changes would be required due to the installation of these barriers.

The industry asserted that EPA's estimate of $14 million in capital costs was too low and that, in addition, significant operational changes with attendant high costs would be required to install the barriers around each retarder due to track clearance problems at approximately half of the retarder locations.

In order to alleviate the causes of these concerns, the agency has developed a revised concept in which retarder noise is required to be abated only when it adversely impacts noise sensitive receiving property in the vicinity of railyards. As such, the regulatory options considered would be effective only on receiving property which is used as residential or commercial or both. The measurement location for compliance would be on the receiving property rather than on the railyard property. This approach would allow the industry to adopt a more flexible arrangement of selective barriers around specific master and/or group retarders and in addition would provide the industry the alternate solution involving the construction of railyard boundary walls in the vicinity of noise sensitive land uses. It is assumed that this approach would substantially eliminate the potential for large operational costs to be incurred by the industry.

Regulatory Options Being Considered

The Agency has considered three options involving different applications of noise abatement technology for which compliance costs are being analyzed. In addition, for each technology option, the Agency has considered the alternative of having the regulation apply to either residential receiving property alone or to both residential and commercial property. Table 6-4 indicates the various options under consideration and their related regulatory levels and compliance costs.

The basic cost elements used to develop the summary Table 6-4 for the abatement alternatives are contained in Table 6-5. A detailed discussion of these cost elements is contained in Appendix B.

Comparison of Regulatory Options

As seen in Tables 6-4 and 6-5, the costs would increase approximately 20 percent if the regulation were to apply to both commercial and residential land use as opposed to residential land use alone. Capital cost estimates for the various options have been based upon a cost per linear foot of \$67-\$100 (\$220 - \$328 per linear meter) for the selected reflective boundary wall configurations. Initial absorptive barrier component material and installation costs near retarders have been based upon a cost of \$162 per linear foot (\$531 per linear meter). Replacement costs for barrier panels which have an estimated useful life of ten years are lower since initial installation costs include the costs of the support structure for the panels. These costs compare with EPA's original estimate of \$75 versus the industry estimate of \$200 per linear foot (\$246 versus \$656 per linear meter) for barriers. Annual unit maintenance costs for barrier panels and property line walls are estimated respectively to be 7.5 percent and 2.0 percent of the initial unit material and installation costs.

Locomotive Load Cell Test Stands

Introduction

The Agency did not propose a source standard for locomotive load cell test stands as part of its proposed rule. Instead in the development of the proposed property line L_{dn} standards, the Agency presumed that full enclosures would be utilized or load cell test stands would be moved in order to comply with the proposed property line rules.

Table 6-4

SUMMARY OF REGULATORY OPTIONS FOR RETARDER NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)	Anticipated Reduction in Max Noise Level (dB)*	Methodological Assumptions	Initial Capital Cost ($ x 10^6)		Capital Recovery Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Annualized Cost ($ x 10^6)		Uniform Annualized Total cost outlay ($ x 10^6)	
					Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
1	Along the hump yard boundary nearest the master retarder a 8 ft x 1500 ft (2.5 m x 457 m) wall is placed and a 8 ft x 1500 ft (2.5 m x 457 m) wall is placed along the opposite boundary	94	9-11	Discount rate: .11 Wall lifetime: 50 years Finance period: 30 years Lead time prior to effective date of regulation: 4 years	15.0	18.0	1.66	1.99	.30	.36	1.96	2.350	1.45	1.74
2	Along the hump yard boundary nearest the master retarder a 15 ft x 1500 ft (4.6 m x 457 m) wall is placed and a 10 ft x 1500 ft (3 m x 457 m) wall is placed along the opposite boundary	84	16-21	Same as above	22.5	27.0	2.49	2.99	0.45	0.54	2.94	3.53	2.17	2.61

Table 6-4 (Continued)

SUMMARY OF REGULATORY OPTIONS FOR RETARDER NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)	Anticipated Reduction in Max Noise Level (dB)*	Methodological Assumptions	Initial Capital Cost ($ x 10^6)		Capital Recovery Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Annualized Cost ($ x 10^6)		Uniform Annualized Total cost outlay ($ x 10^6)	
					Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
3	In addition to the 15 ft x 1500 ft (4.6 m x 457 m) and 10 ft x 1500 ft (3 m x 457 m) walls, absorptive barriers 12 ft x 150 ft (3.7 m x 457 m) are placed on both sides of each master retarder.	83	16-21	Discount rate: .11 Wall lifetime: 50 years Wall finance period: 30 years Barrier lifetime: 10 years Barrier finance period: 5 years Lead time prior to effective date of regulation: 4 years	33.4	40.1	4.3	5.16	0.72	0.87	5.02	6.03	2.94	3.485

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* Refer to footnote on Table 4-6.

Table 6-5

COMPONENT COST ELEMENTS FOR RETARDER NOISE ABATEMENT

Abatement Technology / Cost Element	Total Number Units Existing	Units Required		Initial Component Material and Installation Cost ($)	Initial Total Unit Material and Installation Cost ($)	Unit out of Service Opportunity Cost ($) Due to Installation	Unit Annual Operating and Maintenance Cost ($)	Replacement Component Material and Installation Cost ($)	Replacement Total Unit Material and Installation Cost ($)
		RES.	RES.+ COMM.						
Absorptive barriers for master retarders (12 ft x 150 ft or 3.7 m x 46 m)	124	75	90	$162/ft ($531/m)	48,600	97,000	3,645	$142/ft.	40,824
Reflective walls at yard boundary (8 ft x 1500 ft or 2.5 m x 457 m on side nearest master retarder and 8 ft x 1500 ft or 2.5 m x 457 m on opposite side)	124	75	90	$ 67/ft ($220/m)	200,000	0	4,000	0	0
Reflective walls at yard boundary (15 ft x 1500 ft or 4.6 x 457 m on side nearest master retarder and 10 ft x 1500 ft or 3 m x 457 m on opposite side)	124	75	90	$100/ft ($328/m)	300,000	0	6,000	0	0

The industry took exception to the cost estimates used by the Agency. Whereas the Agency estimated structures to cost $90,000 for materials and installation, the industry estimated the average cost to be approximately $500,000. The discrepancy in system-wide costs was approximately $70 million as the Agency estimated a total cost of $19.4 million whereas the industry estimated a cost of $89.5 million.

In order to achieve the potential benefits associated with noise reduction from load cell test stands at more nominal costs, the Agency decided to investigate the concept of requiring a source standard and basing its stringency upon the use of barrier technology as opposed to full enclosures. This approach, it was believed, would allow the achievement of significant benefits at costs significantly lower than that required of full enclosures. Additionally, if the regulation were only to apply at noise sensitive receiving land uses, rather than at all land uses, the costs could be further reduced without significantly reducing the benefits.

Regulatory Options Being Considered

In developing the specific regulatory noise limit for load cell test stands the Agency has considered two options involving different heights of absorptive barriers which are to be placed around the load cells. In addition, for each technology option, the Agency has considered the option of having the standard apply to either residential receiving property alone or to both residential and commercial receiving property. Table 6-6 indicates the various options under consideration and their related regulatory levels and compliance costs.

The basic cost elements used to develop the summary Table 6-6 for the abatement alternatives are contained in Table 6-7. A detailed discussion of these cost elements is contained in Appendix B.

Comparisons of Regulatory Options

As is seen in Tables 6-6 and 6-7, for each of the land use alternatives, increasing the barrier height from 20 feet (6.1 meters) to 25 feet (7.6 meters) produces an increase in capital and O & M costs of approximately 25 percent. The increase in uniform annualized cost outlays is approximately 23 percent.

Table 6-6

SUMMARY OF COSTS FOR REGULATORY OPTIONS FOR LOCOMOTIVE LOAD CELL TEST STAND NOISE ABATEMENT

Option	Technical Descripton	A-Weighted Regulatory Limit (dB)	Reduction in Max Noise Level (dB)	Methodological Assumptions	Initial Capital Cost ($ x 10^6)		Capital Recovery Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Annualized Cost ($ x 10^6)		Uniform Annualized Total Cost Outlay ($ x 10^6)	
					Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
1	For each Load Cell Test Stand in hump and flat classification yards absorptive barriers 20′ high by 150′ long are placed on each side at 25′ from track centerline.	80 (a) 30 meters	13	Discount rate: .11 Barrier lifetime: 10 years Finance period: 5 years Lead time prior to effective date of regulation: 4 years	11.0	11.2	1.79	1.82	0.83	0.84	2.62	2.66	1.941	1.984
2	Same as Case 1 except that barrier height is increased to 25′.	78 (a) 30 meters	15	Same as above	13.65	14.0	2.23	2.28	1.04	1.05	3.27	3.33	2.40	2.446

Table 6-7

COMPONENT COST ELEMENTS FOR LOCOMOTIVE LOAD CELL TEST STAND NOISE ABATEMENT

Abatement Technology	Cost Element	Total Number Units Existing	Units Required		Initial Component Material and Installation Cost ($)	Initial Total Unit Material and Installation Cost ($)	Unit out of Service Opportunity Cost ($) Due to Installation	Unit Annual Operating and Maintenance Cost ($)	Replacement Component Material and Installation Cost ($)	Replacement Total Unit Material and Installation Cost ($)
			RES.	RES.+ COMM.						
Absorptive barriers 20 ft x 150 ft (6.1 m x 45.7 m)		189	141	144	$260/ft ($853/m)	78,000	0	5,850	$228/ft ($748/m)	63,370
Absorptive barriers 25 ft x 150 ft (7.6 m x 45.7 m)		189	141	144	$325/ft ($1,066/m)	97,500	0	7,312	$285/ft ($935/m)	85,462

Comparison of the increased costs to include both residential and commercial land use as compared with residential only indicates that approximately a 2 percent increase occurs. The percentage of the 189 load cells which require barriers as a result of their location near residential or commercial land use has been based upon the EPIC overlays and the U.S.G.S maps using the data base described in Appendix K. From these sources it has been estimated that 141 load cells would require treatment for the residential only situation whereas only three additional load cells would require treatment if commercial land use were to be also included.

It is noted that the total unit material and installation costs for the various heights of absorptive barriers considered are comparable to the Agency's original estimates of $90,000 for simple enclosures, yet significantly lower than the industry's estimates for enclosures.

Annual unit increases in maintenance costs associated with the absorptive barriers are estimated to be 7.5 percent of the initial unit material and installation costs.

In addition the Agency has estimated that minimal out-of-service costs would result from the installation and periodic replacement of barriers around load cell test stands.

The computation of capital recovery cost and uniform annualized total cost outlays utilize a discount rate of 11 percent and a lead time of four years before the regulation becomes effective. Additionally, barrier panels are estimated to need replacement an average of every ten years. Replacement costs are lower since initial capital and installation costs include associated support structures.

Car Coupling

Introduction

The Agency originally proposed an A-weighted sound level of 95 dB as the source standard for noise emissions resulting from car coupling operations which included an exception provision in situations where it was demonstrated that cars were traveling at speeds no higher than four miles per hour even though the noise limit was exceeded. The Agency ascribed no cost to the proposed standard on the basis that this approach only codified existing operational rules.

The railroad industry took exception to the use of the four mile per hour speed limit as a basis for the proposed rule. They contended that four miles per hour is a goal or guideline and not a hard rule. Data were submitted during the docket period indicating that in actual practice more than 60 percent of car couplings occur at speeds greater than four miles per hour, that 17 percent occur at speeds greater than six miles per hour and approximately 3 percent occur at speeds greater than eight miles per hour. The industry asserted that if they were forced to slow to the standard's level of four miles per hour, the flow of traffic would be impeded with the result that major operational changes would be needed at a cost of approximately $10 billion.

In order to mitigate the causes of these concerns yet still achieve some degree of protection from the adverse impacts associated with car coupling impact, the Agency has decided to consider several alternatives involving relaxing the noise limit to correspond more closely to either typical existing or worst case practice rather than operational guidelines or rules. Additionally, industry comments indicated that while four miles per hour can be difficult to obtain because of the large number of variables involved in controlling coupling speeds, 6 mph to 8 mph are more reasonable targets from a technological viewpoint and that such speeds are desirable as an upper bound on coupling speeds in order to minimize freight damage and resultant insurance losses. Additionally, the Agency has decided to consider a revised concept in which car coupling noise is required to be abated only when it adversely impacts noise sensitive receiving property in the vicinity of railyards. As such, the Agency has considered the alternative of having the regulation apply to either residential receiving property alone or to both residential and commercial receiving property. The measurement location for compliance would be on the receiving property rather than on the railyard property. These two new elements were believed to substantially eliminate the causes of concern expressed by the industry.

Regulatory Options Being Considered

In developing the specific regulatory limit for car coupling noise reduction, the Agency has considered five options based upon differing degrees of speed control and associated exemptions in situations where the noise limit is exceeded despite the achievement of the requisite coupling speed. The uncertainty in the costs does not allow for a convenient comparison. In addition, for each technology option the Agency has considered the alternative of having the regulation apply to either residential receiving property alone or to both residential and commercial receiving property. Table 6-8 indicates the various options under consideration and their related regulatory levels.

Comparion of Regulatory Options

No cost information is included in Table 6-8 as it is presumed that the noise limits based upon the 8 mph coupling speed can be achieved with minimal cost on a national average basis whereas the noise limits associated with the 4 mph limit are believed to be substantial although unknown. The costs associated with the 6 mph limit are not believed to be minimal yet not of the same magnitude as the costs associated with the 4 mph limit.

Data Uncertainties or Methodological Problems

The major uncertainty in the car coupling analysis involves the null cost hypothesis for restricting car coupling operations to speeds no higher than 6 or 8 mph. Conrail data suggests that only 17 percent of car couplings occur at speeds greater than 6 mph and approximately 3 percent occur at speeds greater than 8 mph; however, a 1972 study by the National Transportation Safety Board* indicates that approximately 32 percent and 7 percent of the couplings at the East St. Louis yard occurred at speeds greater than 6 mph and 8 mph.

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*"Railroad Accident Report - Hazardous Materials Railroad Accident in the Alton and Southern Gateway Yard in East St. Louis, Illinois, January 22, 1972," Report NTSB-RAR-73-1, National Transportation Safety Board, Washington, D.C.

Table 6-8

SUMMARY OF REGULATORY OPTIONS FOR CAR COUPLING NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)	Anticipated Reduction in Max Noise Level (dB)
1	Car coupling impact noise is reduced as a result of restricting coupling speeds to occur at no higher than 6 mph; the noise limit is based upon reductions in the statistical average of max levels derived from integrating the coupling speed vs impact noise level relationship with the probability distribution of coupling speeds; As the coupling speed distribution is skewed to place all impacts below 6 mph, a reduced average max noise level is produced. Additionally, this option provides an exemption if rail yards can demonstrate that their coupling speeds are in fact no higher than 6 mph and yet they cannot comply with the noise limit.	91	2
2	Same as option 1 except no exemption is included for coupling at speeds no higher than 6 mph which otherwise cannot meet the noise limit.	91	2

Table 6-8 (Continued)

SUMMARY OF REGULATORY OPTIONS FOR CAR COUPLING NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)	Anticipated Reduction in Max Noise Level (dB)
3	Same as option 1 except noise limit is based upon 4 mph coupling speed restriction.	85	8
4	Same as Option 2 except noise limit is based upon 8 mph coupling speed restriction.	92	1
5	Same as Option 1 except noise limit is based upon 8 mph coupling speed restriction.	92	1

Current car coupling speeds in flat yards are affected by the fact that these yards are built whenever possible to have a slight downward slope from either end. In this manner, cars entering the yard through the leads will roll slowly down hill until coupling with a string of cars already on a given classification track. If there are no cars on the track, they will roll to the approximate center of the yard and stop.

In 1929, a series of experiments were carried out as to the rollability of freight cars. The conclusions of these experiments was that the ideal downward slope of a flat yard was a 0.2 percent gradient. From that time to the the late 1950's, virtually all yards built were fixed with this gradient. On rare occasions, yards which handled primarily empty cars were given even steeper slopes because of the lower rollability of empties. By the later 1950's it had become apparent that advances in car technology, most particularly the widespread use of roller bearings, had introduced new variables into the operation of flat yards. New rollability tests were made over a range of cars and it was concluded that the ideal gradient was no longer 0.2 percent, but rather 0.08 percent. From 1960 on, all new flat yards and also yards receiving extensive overhaul were modified to this new gradient. It is estimated, however, that 75 percent of existing yards have a 0.2 percent gradient.

Coupling operations in these older yards are normally handled without any special precautions. Thus, cars which are released into the classification tracks that are nearly empty may roll a considerable distance and build up speed, thereby creating relatively high impact coupling. If a lower coupling speed is desired, the operational solution is to send a car into each classification track with a switchman riding it. He stops the car with the handbrake and applies the handbrake firmly at a distance down the track which is less that that required for cars to build up excessive speed. Cars are then switched into the classification track until there is no more room for them. At this time, the string of cars must be moved farther into the yard in order to make room for the next batch of cars switched onto that track. In pushing the string of cars down the classification track, the brake on the far car may or may not be released. In any event, the locomotive must push this string of cars into the yard in order to make room for additional cars. If one sums the operating times involved in the various unitary activities in both switching and shoving down the classification tracks, it appears that the time to switch one car is approximately doubled when the above described procedure is used.

There are two major economic consequences of incurring extended switching times. The first involves the direct additional pay to the switch crew resulting from the longer time spent to do a given job. The second consequence which in many cases may be more important but is more difficult to estimate is that the yard in question will suffer a reduction of peak capacity by approximately a factor of two. In some cases, this may be of little consequence, but in others it may result in a loss of large amounts of business to other carriers or other modes and thereby have a serious economic impact.

Modification of an existing flat yard can be accomplished by bringing in fill material and elevating the tracks in the center so as to have a 0.08 percent grade. A typical yard, 4,500 feet (1,370 meters) long by 20 tracks wide, will require approximately 1,000,000 cu yds (760,000 cu meters) of fill to bring it to the new grade. Ninety thousand feet (27,000 meters) of track must be relaid. If this job is done while the yard is in operation, it will involve closing off parts of the yard over a period of six to eight weeks.

Switcher Locomotives

Introduction

The Agency did not propose a source standard for switcher locomotives as part of its proposed rule. Instead, in the development of the proposed property line L_{dn} standards, the Agency presumed that moving and idling switcher locomotives would have to be treated using retrofit muffler technology or that idling switcher locomotives would have to be moved or shut down in order to meet the proposed property line rules.

The industry took strong exception to the Agency's contention that retrofit muffler technology existed to reduce the noise emission from switcher locomotives an average of 3 dB at idle and 4 dB while moving at the most common throttle positions. The industry also contended that the Agency underestimated the retrofit hardware and installation costs, and that idling locomotive shutdown was not feasible. Additionally, they contended that retrofit costs should also include out-of-service costs resulting from the downtime and that the Agency did not consider in its costing retrofitting the large number of road haul locomotives which are often used to augment the dedicated switcher fleet. The industry asserted that 450 new road locomotives would have to be purchased to replace those road haul locomotives which would have to be dedicated to yard operations in order to obviate the need to retrofit all road haul locomotives which are currently used in switcher operation.

The result of these discrepancies was an industry capital cost estimate of $582 million as compared with the Agency estimate of $7.9 million.

Since switcher locomotives contribute more than half of the total noise impact associated with railyards, the Agency decided to consider promulgating a source regulation to control switcher locomotive noise. It was believed that, despite the technology uncertainties, a nominal level of noise reduction could be achieved at reasonable costs. In order to eliminate the potential problem created by road haul locomotives used in switching, the Agency decided to consider regulatory options restricted to the inclusion of only those existing switcher locomotives that are currently identified by the industry and the ICC by name and model as dedicated to yard service. Additionally, the Agency revised its unit cost estimates to include hardware, labor and out-of-service costs.

Regulatory Options Being Considered

The regulatory options under consideration differ with respect to the level of noise reduction believed to be achievable using retrofit muffler technology in the idle and throttle 1 and 2 settings during which switcher locomotives operate more than 90 percent of the time. In addition, options are distinguished by applicability of the standard to either residential or residential and commercial receiving land use. Table 6-9 indicates the various options under consideration, their regulatory levels and compliance costs. The basic cost elements are contained in Table 6-10. A detailed discussion of these cost elements is contained in Appendix B.

Comparison of Regulatory Options

As indicated in Tables 6-9 and 6-10, a range of compliance costs is presented for each land use alternative, reflecting differing scenarios of both the lead time prior to the effective date of the regulation and assumptions regarding the average lifetime of the retrofit exhaust mufflers which are presumed to be used to achieve the requisite noise abatement. For the eight year lead time and eight year muffler lifetime situation, both the initial retrofit and subsequent replacement retrofits are presumed to occur within the normal maintenance cycles (six years) of the switcher locomotives; therefore no out-of-service (opportunity) costs would be charged to the regulatory option under this scenario. At the other extreme, if a four year lead time prior to the effective date were assumed in conjunction with a four year useful life of the exhaust mufflers utilized, both an initial and a periodic replacement out-of-service cost for approximately one-third of the fleet would be chargeable to the regulatory option since only this fraction of the required retrofits could be accommodated during normal maintenance cycles.

As a result, the cost bounds indicated in Table 6-9 for both initial capital costs and uniform annualized costs reflect the additional out-of-service costs resulting from differing regulatory lead times and replacement rates for mufflers.

The compliance costs associated with retrofitting switcher locomotives assume that for the residential only land use alternative 57 percent of the yards will have to retrofit their dedicated switchers. Similarly 73 percent

Table 6-9

SUMMARY OF COST FOR REGULATORY OPTIONS FOR SWITCHER LOCOMOTIVE NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)		Anticipated Reduction in Max Noise Level (dB)		Methodological Assumptions	Initial Capital Cost ($ x 10^6)		Capital Recovery Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Annualized Cost ($ x 10^6)		Uniform Annualized Total Outlay ($ x 10^6)	
							Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
1	Minimum noise reduction. Assumes no noise reduction is achieved at idle, and 1 dB reductions are achieved for switcher operations which are composed of 50% untreated road haul locomotives and 50% dedicated switcher locomotives which are treated to achieve 2 dB reductions.	70 Idle	90 Moving	0	2	Nuffler lifetime: 8 years 4 years Finance period: 3 years Discount rate: .11	31.5 (8 year lead time)	40.3	6.13	7.85	4.97 (8 year muffler replacement)	6.38	11.1	14.2	5.148	6.587
							to		to		to		to		to	
							42.6 (4 year lead time)	54.6	13.71	17.56	4.97 (4 year Muffler replacement)	6.38	18.68	23.94	10.54	13.51

Table 6-9 (Continued)

SUMMARY OF COST FOR REGULATORY OPTIONS FOR SWITCHER LOCOMOTIVE NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)		Anticipated Reduction in Max Noise Level (dB)		Methodological Assumptions	Initial Capital Cost (\$ x 10^{6})		Capital Recovery Cost (\$ x 10^{6})		Annual O & M Cost (\$ x 10^{6})		Annualized Cost (\$ x 10^{6})		Uniform Annualized Total Outlay (\$ x 10^{6})	
							Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
2	Nominal noise reduction. Assumes noise level reductions are achieved for switcher operations which are composed of 50% untreated road haul locomotives and 50% dedicated switcher locomotives. Treated switchers achieve 4 dB reductions while moving and 3 dB at idle.	67 Idle	88 Moving	3	4	Same as Option 1	Same as Option 1		Same as Option 1		Same as Option 1		Same as Option 1		Same as Option 1	

Table 6-9 (Continued)

SUMMARY OF COST FOR REGULATORY OPTIONS FOR SWITCHER LOCOMOTIVE NOISE ABATEMENT

Option	Technical Description	A-weighted Regulatory Limit (dB)		Anticipated Reduction in Max Noise Level (dB)		Methodological Assumptions	Initial Capital Cost ($ x 10^6)		Capital Recovery Cost ($ x 10^6)		Annual O & M Cost ($ x 10^6)		Annualized Cost ($ x 10^6)		Uniform Annualized Total Outlay ($ x 10^6)	
							Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only.	Res.+ Comm.	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
3	Optimistic noise reduction. Assumes noise level reductions are achieved for switcher operations which are composed of 100% treated switcher locomotives. Road haul locomotives, albeit present, are assumed to operate for minimal durations and therefore contibute insignificantly to the noise emissions from switcher operations.	67 Idle	88 Moving	3	4	Same as Option 1	Same as Option 1		Same as Option 1		Same as Option 1		Same as Option 1		Same as Option 1	

Table 6-10

COMPONENT COST ELEMENTS FOR SWITCHER LOCOMOTIVE NOISE ABATEMENT

Cost Element / Abatement Technology	Unit Type	Total of Units Existing	Units Required		Initial Unit Material and Installation Cost ($)	Lead Time Prior to Effective Date of Regulation (Years)	Unit out of Service Opportunity Cost ($) Due to Initial Installation	Unit Annual Operating + Maintenance Cost ($)	Replacement Unit Material + Installation Cost ($)	Muffler Useful Life Years	Unit out of Service Opportunity Cost ($) Due to Replacement Installation
			RES.	RES.+ COMM.							
Exhaust Muffler, + related materials for installation	EMD 645 series	305	173	223	6,800	4	8,000	460(fuel) + 680(maint) =1,140	5,000	4	8,000
						4	8,000			8	0
						8	0			4	8,000
						8	0			8	0
	EMD 567 series	5,809	3,312	4,240	7,300	4	8,000	460(fuel) + 730(maint) =1,190	6,000	4	8,000
						4	8,000			8	0
						8	0			4	8,000
						8	0			8	0
	other manuf.	860	491	629	12,500	4	8,000	460(fuel) +1,250(maint) =1,710	6,000	4	8,000
						4	8,000			8	0
						8	0			4	8,000
						8	0			8	0

of the yards will have to retrofit their dedicated switchers if the regulation were to apply to both residential and commercial land uses surrounding rail yards. In the development of the capital costs, initial retrofits of EMD switchers average \$7,275 and other switcher retrofit costs average \$12,500. Initial retrofit costs include provisions for fabrication of a hatch bonnet and other modifications which are not required for subsequent muffler replacements.

Annual operations cost increases of \$460 per engine are included in costs of compliance due to increased fuel costs. In addition, annual maintenance costs increases of 10 percent of initial material and installation costs are included resulting from the cleaning of sound arrestor/exhaust silencer assembly and retorquing of bolts.

Measurement Costs

In the original Agency proposal for a property line standard, the Agency estimated that instrumentation required to monitor the property line L_{eq} and L_{dn} for compliance would cost approximately \$10,000 per set. These costs were based upon the anticipated requirement for the purchase of a Type 1 sound level meter, microphone, windscreen, calibrator and community noise classifier. Approximately 590 instrument sets were estimated to be required resulting in a total initial capital investment of \$5.97 million. Annual labor costs were estimated to be between \$500 and \$2,000 per year depending upon yard size to monitor the property line levels and the specific railyard sources. The industry did not take exception to the initial capital investment costs or the 5-year useful life estimation except to note that the \$10,000 cost per instrument set would not be sufficient to procure a strip chart recorder and a tape recorder which could assist in the identification of individual noise sources. They did, however, take exception to the estimated labor costs asserting that they should be increased by more than a factor of four.

In developing the revised regulatory concepts which are not based upon the measurement of receiving property L_{eq} or L_{dn} values, the instrumentation costs and annual labor costs can be substantially lowered. Since the regulatory options under consideration only require the measurement of maximum A-weighted sound levels, only Type 1 or Type 2 sound level meters plus associated microphone, windscreen and calibrator will be required. Additionally, because 24 hour measurements will not be required the labor costs will be more nominal than in the proposed standard.

Table 6-11 summarizes the compliance costs associated with the purchase and annual operating costs associated with the monitoring of the four noise sources which are considered for regulation.

It is estimated that each of the 500 railroad companies which will have to comply with the standard would purchase one instrument set at an initial capital cost of approximately $2,000. This would include the purchase of a Type 1 and/or a Type 2 sound level meter and associated microphone, windscreen and calibrator.

Annual maintenance costs are based upon 10 percent of initial capital costs. Annual operating (labor) costs to perform the measurements are estimated to be $2,000 per yard based upon 3 to 5 sources per average yard. Each yard will be measured once every five years to ensure compliance.

For the regulatory option which applies to residential receiving property only, 2,501 yards are estimated to require measurement whereas in the residential and commercial case 3,127 are estimated to require measurement.

ECONOMIC AND FINANCIAL IMPACT OF RAILYARD NOISE ABATEMENT REGULATIONS

Summary of Economic Impacts

The analysis presented in this section evaluates the probable impact of increased costs on the railroad industry resulting from railyard noise

Table 6-11

SUMMARY OF MEASUREMENT COSTS FOR REGULATORY OPTIONS

Cost Category Land Use	Initial Capital Cost ($ x 10^6)	Annual Operating and Maintenance Cost ($ x 10^6)	Methodological Assumptions	Capital Recovery Cost ($ x 10^6)	Annualized Cost ($ x 10^6)	Uniform Annualized Total Cost Outlay ($ x 10^6)
Residential only	1.0	1.10	Discount rate: .11 Instrument useful life: 5 years Finance period: 3 years Lead time prior to effective date of regulation: 4 years	0.29	1.37	0.982
Residential + Commercial	1.0	1.35		0.27	1.62	1.16

abatement regulations. The analysis uses two separate techniques; one intended to highlight the economic impacts in the rail freight transportation industry; the second designed to look at individual railroads' discounted cash flows over the future and compare this with costs of noise abatement.

Some of the major conclusions from the economic impact analysis are summarized in Table 6-12. The cost of the noise abatement regulations may lead to a .1 percent increase in the price of rail freight transportation services in the United States. This price increase translates into a decrease in the traffic originating in Class I and II railroads of between 314 and 1279 million revenue ton-miles. This decrease will lead to a reduction of between 192 and 777 jobs in the industry. However, both the employment decreases and output reductions may be totally offset if the demand for rail freight transportation increases, even modestly. Given the recent rapid escalation of fuel prices and the concurrent noise regulation of new trucks, it seems likely that the demand for rail freight services will increase.

The question of the impact on individual railroads is also particularly important. The impact of noise abatement regulations on the railroad industry as a whole appears to be very small, but some railroads may be more adversely affected than others. Conrail is of special interest because of the large government subsidies it already receives. The analysis performed for this section suggests that Conrail's costs will rise by about .2 percent of total capital plus operating costs. The number of revenue ton-miles shipped by Conrail will fall between .06 and .23 percent if the full increase in costs is passed through as a price increase. After Conrail, the railroad with the largest deficit relative to operating revenues affected by the regulations is the Chicago, Milwaukee, St. Paul and Pacific. It is smaller ranking 15th in terms of revenue ton-miles of the 49 Class I and II railroads studied. Although total costs will increase by only .2 percent, traffic will decrease by .09 to .28 percent. These are small changes, but given that the railroad is already operating with a deficit, the impacts are relatively large.

Table 6-12

SUMMARY OF ECONOMIC IMPACTS FOR CLASS I AND II LINE HAUL RAILROADS

		Residential Receiving Property		Residential/Commercial Receiving Property		Industry Characteristics for 1978		
		Low	High	Low	High			
Output decrease (million of ton-miles)	Min	0	0	0	0	Output (Millions of ton miles)	Min	198
	Tot	314	1040	391	1279		Tot	585,105
	Max	57	175	71	218		Max	108,124
Employment decrease (millions of ton-miles)	Min	0	0	0	0	Employment	Min	259
	Tot	192	635	236	777		Tot	471,516
	Max	56	172	70	215		Max	91,318
Price increase (in percent)	Min	0		0		Price - (¢ per ton-mile)	Min	1.51
	Avg	0.1		0.1			Avg	2.37
	Max	0.5		0.6			Max	8.49

Two of the railroads with the largest increase in costs relative to total capital plus operating costs are the Pittsburgh and Lake Erie, and the Richmond, Fredericksburg and Potomac. Costs could increase by as much as .4 and .5 percent, respectively (or as little as .4 and .3 percent, respectively). Both are small railroads, ranking 38th and 39nd respectively in revenue ton-miles shipped in 1978, but they should be better able to absorb increased costs in the short run than many of their competitors. The Pittsburgh and Lake Erie's net income as a percent of total operating revenue was 16.6 percent in 1978, and that of the Richmond, Fredericksburg and Potomac was 43.8 percent.

The major conclusion reached is that the noise abatement regulations as posed and evaluated in this chapter should lead to only minor impacts in the rail freight transportation industry in the short run and in the long run after railroads have had the chance to pass through added costs. Employment impacts likewise will be extremely small, with no reduction in jobs in some firms. Conrail may experience a reduction of as many as 215; however, even this reduction in employment amounts to less than one quarter of one percent of Conrail's total labor force.

Description of Methodology Used

The two methodologies used to calculate the economic and financial impacts of railyard noise abatement regulation address two different but highly interrelated questions: first, how will the market respond to cost and price increases brought about by the noise abatement fixes; and second, what will be the impact on individual railroads incurring the costs of these fixes? The first question is addressed using a highly simplified economic model of the railroad industry. The second question is addressed by modeling expected future railroad cash flows over the life of the quieting fixes.

Economic Impact Analysis

An economic model of the railroad industry was developed, using simplifying assumptions, to forecast the impacts of the candidate noise abatement techniques specified in the final regulation. The model is described below, with justification for its use and its key underlying assumptions. The major caveat to be emphasized is that the model does not address intermodal competition directly, a potentially serious mis-specification that cannot be fully justified. However, to the extent that trucks are currently subject to noise regulation, and their capital and operating costs increase by the same order of magnitude that rail costs increase, no distortions will be introduced into the analysis. Additional considerations will be noted below.

The Railroad Impact Methodology:

The methodology used to compute economic impacts of cost increases brought about by noise abatement technology is based on a number of assumptions about the railroad freight industry.* The most important assumptions are the following:

1) Firms in the railroad industry behave competitively as profit maximizers. Even if there is little opportunity for competition between individual railroads, the existence of other transport modes ensures that railroads must price their services competitively.

2) Railroads are characterized by moderate economies of scale and significant economies of density. In practice this means that once a railroad achieves even moderate size as measured by its miles of road (given traffic density measured in revenue ton-miles per mile of road), its average costs of operation per ton-mile are constant (and its marginal costs equal average costs).

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*It should be noted that the impact on passenger transportation has been ignored. It is legitimate to disregard these impacts only if they are expected to be negligible. Railroads currently account for less than 5 percent of all revenue passenger miles by mode; passenger revenues were approximately three percent of total operating revenues for all Class I railroads in 1978. Finally, two railroads, the Long Island and Conrail, accounted for over 70 percent of all revenue passenger miles for Class I railroads in 1978. However, the majority of these passenger are commuters who should be relatively insensitive to price changes. Thus it is assumed that passenger traffic will not be affected substantially by the noise abatement regulations.

3) The Interstate Commerce Commission will allow the full cost increase due to noise abatement fixes to be passed on to railroad customers in terms of higher prices. However, the price increases will not be instantaneous as railroads must petition the ICC for the increase. Thus, in the short run, even as costs rise, freight charges will not. Given sufficient time, six months to a year, the full cost increase will be passed through.

The remaining assumptions are somewhat more tenuous, but without a much larger expenditure of resources to develop a truly general rail industry model, they are the only workable alternative.

4) The increase in rail freight prices relative to other modes' freight transport prices will be very small; thus additional intermodal substitution will not occur.

5) Service differentials will not change (i.e., delivery times for rail freight will not increase relative to other modes). Thus no substitution between modes will be spurred due to changes in service differentials.

6) The price elasticity of demand faced by each railroad is constant for sufficiently small changes in price and output. This assumption is really a consequence of the preceding two. As will be demonstrated later in this section, average cost increases per ton-mile are a very small proportion of average revenue per ton-mile; thus assuming that the price elasticity is constant will not lead to very large distortions.

Based on these assumptions, the demand for and supply of railroad freight transportation services are depicted in Figure 6-2. The shaded region between the two demand curves represents the area in which the equilibrium price and output would fall if costs change (and consequently the supply curve shifts). The more steeply sloped demand curve DD represents an elasticity (in absolute value) of less than 1 (.348) and the more gently sloped demand

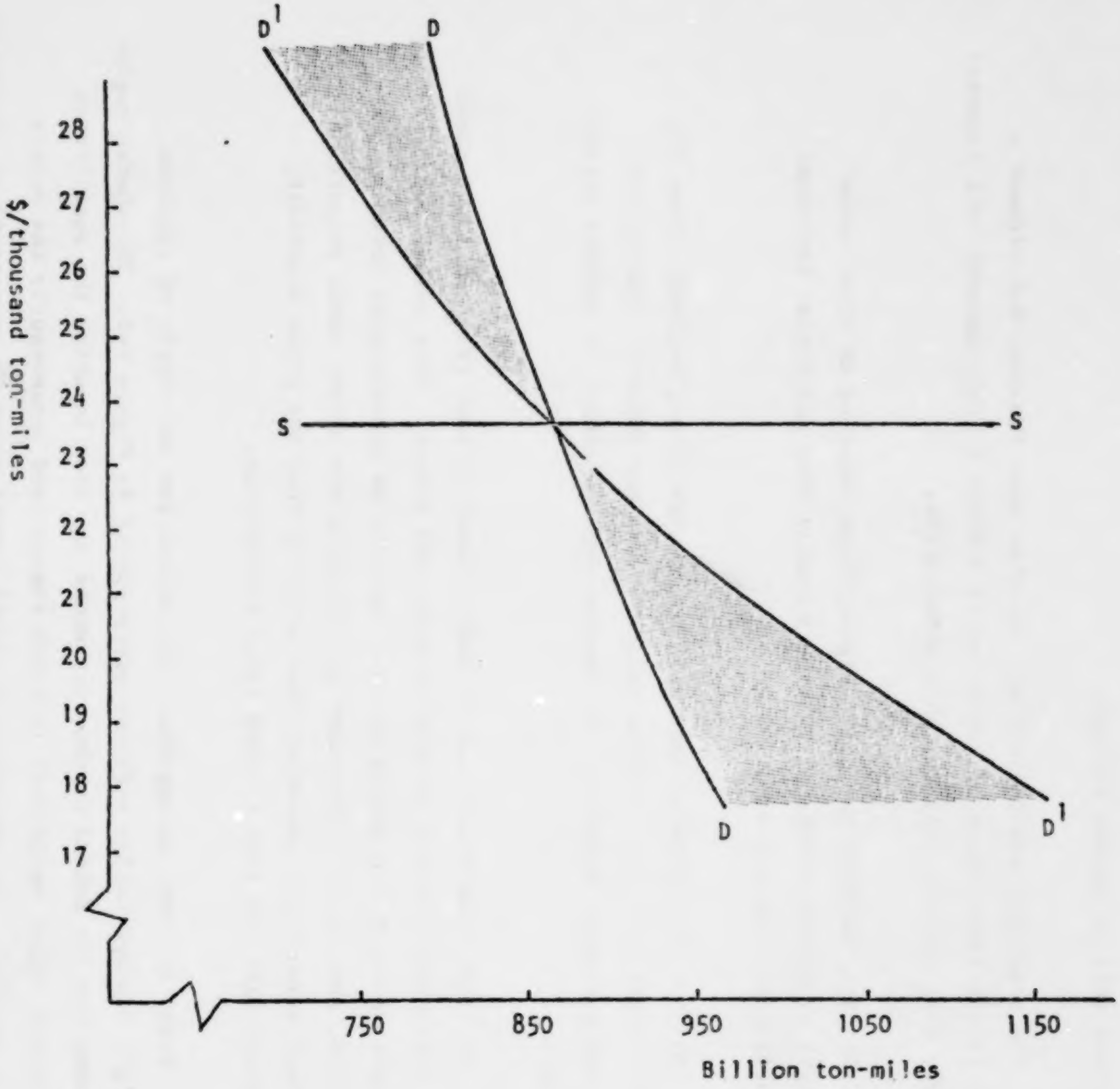

FIGURE 6-2. SUPPLY AND DEMAND RELATIONSHIPS

curve D'D' represents an elasticity greater than 1 (1.037).* The intersection of the supply curve SS and demand curves at 858.1 billion ton-miles and average revenue (or price) of $23.65 per thousand ton-miles are the observed 1978 values.

Conceptually, the steps that are necessary to find the new equilibrium price and output are as follows:

1) Costs associated with the noise abatement fixes are calculated on a per ton-mile basis.

2) These cost increases are added to the average cost per ton-mile at the original equilibrium point. Graphically, the supply curve shifts upward by the unit cost increase.

3) At the new intersection of the demand and supply curves, the equilibrium price and quantity can be read from the graph.

Computationally, the steps are quite similar to those above. The basic relationship to be used is the definition of the elasticity:

$$N_d = \frac{\%\Delta Q}{\%\Delta P}$$

i.e., the price elasticity of demand is defined as the percentage change in output divided by the percentage change in price. The percentage change in price is calculated as the change in cost due to the noise abatement fixes (these costs are passed on to railroad customers in the form of a price increase) divided by the average revenue per ton-mile, a crude proxy for the average price per ton-mile, the freight rate. Multiplying the percentage change in price by the elasticity gives the percentage change in output. Because the pre-regulation output is known, the change in output can be calculated by multiplying the percentage change by total output. This can be done on a railroad by railroad basis, and the results aggregated to the industry level.

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*Throughout this section, the price elasticity of demand will be reported using the absolute value, omitting the minus sign which is consistent with the downward-sloping demand curve.

Employment impacts are calculated under the assumption that for small changes in output, the output-labor ratio is constant. Dividing the change in output by the output-labor ratio will thus generate the change in employment. Again, a predicted reduction in employment is a long-run change. The immediate response of railroads to the cost increase will depend on the rapidity with which the ICC allows increased costs to be reflected in the price of rail services. Consequently, there will be no immediate reduction in employment. Given sufficient adjustment time, and if the employment impact is small, employment adjustments can be accomplished through normal attrition.

Developing Average Elasticities:

Much of the accuracy of the analysis depends on utilizing reasonable figures for the price elasticity of demand. Unfortunately, there is little recent information on railroad price elasticities and that which does exist is not completely appropriate for the analysis here. In an analysis of competition between two railroad technologies (boxcars and TOFCs) and trucks, Levin* found that the average price elasticity of demand for 42 commodities to be in the range of .25 to .35. The only other recent source of price elasticities by commodity is the ICC.** Unfortunately, commodity categories were aggregated across some 2-digit STCC commodity classifications so that the resulting elasticities could not be directly applied to the STCC classifications contained in the railroads' annual reports. However, the elasticities shown in Table 6-13 were used to compute weighted average elasticities for

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*R. C. Levin, "Allocation in Surface Freight Transportation: Does Rate Regulation Matter?" The Bell Journal of Economics 9 (Spring 1978): 32.

**ICC Report to Congress, The Impact of the 4R Act: Railroad Ratemaking Provisions, October 5, 1977, Table V-3, p.103.

Table 6-13

ELASTICITIES BY STCC COMMODITY CLASS

STCC	Commodity	Elasticity	
		Low	High
01	Farm Products	.837	1.320
10	Metallic Ores	.390	.819
11	Coal	.128	.380
32	Stone, Clay, Glass	.350	4.4
33	Primary Metal Products	.100	.300
37	Transportation Equipment	.760	1.680

each railroad. Elasticities were computed for each railroad by multiplying the tonnage hauled in each commodity class by the related elasticities. These were added for all railroads. Finally, the total was divided by the total tonnage summed over the six commodities classes listed above. Thus, each railroad's average elasticity of demand is weighted by the type of commodities it hauls. These composite elasticities were aggregated over all railroads, weighting each railroad's elasticity by its total revenue ton-miles. The resulting industry-wide weighted price elasticity of demand ranges between a low of .348 and a high of 1.037. These are considerably larger (in absolute value) than those estimated by Levin, but are similar to elasticities estimated by Friedlaender in 1969.*

Computing Unit Cost Impacts:

Costs of the noise abatement fixes were computed by applying the unit capital and operating and maintenance costs discussed above and summarized in Table 6-14, to noise sources by individual railroads. Thus quieting costs associated with retarders were multiplied by the number of hump yards owned by each railroad, and the quieting costs for load cells were multiplied by the number of hump yards owned by each railroad, and the quieting costs for load cells were multiplied by the number of load cells owned by each railroad.** Quieting costs for switch engines were developed assuming a 4-year muffler replacement cycle. These were multiplied by an estimate of the total number of engines requiring treatment owned by each railroad to obtain the total cost of the treatment.

The total cost of each treatment was restated as an average or annualized cost in order to compute the average annual increase in costs. For the absorptive barriers used in the retarder and load cell treatment, a useful

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*Ann F. Friedlaender, The Dilemma of Freight Transport Regulation (Washington, D.C.: The Brookings Institution, 1969) pp.28-64.

** The three load cells already quieted by Louisville and Nashville and Illinois-Gulf Central railroads were excluded.

Table 6-14

COSTS FOR SOURCE STANDARDS

Noise Source	Treatment	Unit Cost $ (000)	Number of Units	Annual O&M Cost $ (millions)
FOR RESIDENTIAL RECEIVING PROPERTY				
1. Retarders	Absorptive barriers for master retarders, 12 ft x 150 ft (3.7 m x 46 m)	48.6	75	0.72
	Boundary walls 15 ft x 1500 ft (4.6 m x 457 m) and 10 ft x 1500 ft (3 m x 457 m)	300.0	75	
	Out-of-service costs	97.0	75	
2. Locomotive Load Cell Test Stands	Absorptive barriers, 25 ft x 150 ft (7.6 m x 46 m)	97.5	141	1.04
3. Switcher Muffler Locomotives				
	EMD Engines	7.28	3,485	4.97
	Other Engines	12.5	491	
	Out of Service Costs (10 days)	8.0	1,392	
4. Car Coupling	Speed Control			
FOR RESIDENTIAL/COMMERCIAL RECEIVING PROPERTY				
1. Retarders	Absorptive barriers for master retarders, 12 ft x 150 ft (3.7 m x 46 m)	48.6	90	0.87
	Boundary walls, 15 ft x 1500 ft (4.6 x 457 m) and 10 ft x 1500 ft (3m x 457 m)	300.0	90	
	Out-of-service costs	97	90	
2. Locomotive Load Cell Test Stands	Absorptive barriers, 25 ft x 150 ft (76 m x 46 m)	97.5	144	1.05
3. Switcher Muffler Locomotives				
	EMD Engines	7.28	4,463	
	Other Engines	12.5	629	
	Out of Service Costs (10 days)	8.0	1,782	6.38
4. Car Coupling	Speed Control			

life of 10 years was assumed; for the reflective property line boundary walls used to abate retarder noise, a 50-year useful life was estimated. As stated above, the life of the muffler treatment was assumed to be 4 years. The present value of capital costs and operating and maintenance costs were combined. Table 6-15 summarizes the total capital and operating and maintenance cost estimates used in the calculations.

Financial Analysis/Impact Assessment

Further analysis was performed to assess the impact of the railyard noise controls on individual railroad cash requirements and financial conditions. Using a discounted cash flow technique, the net present value (NPV) of each railroad's twenty year (1980 to 1999) stream of adjusted cash flow is compared to the NPV of noise abatement costs plus net investment for the same period. When the costs plus net worth are greater than or slightly less than adjusted cash flow, or where abatement costs seem large relative to adjusted cash flow, potential financial difficulty may be present, and further examination is warranted.

Adjusted cash flow is defined as the sum of net income after interest, income taxes, extraordinary items and deferred taxes, less equity in earnings of affiliated companies. Net investment is defined as net worth (the difference between assets and liabilities) and is composed of capital stock, capital contributions and retained earnings. Net worth represents that portion of total assets or investments which are owned by the company's shareholders and not by creditors.

The cash flow study encompasses a total of 56 railroads. Using the ICC designations in effect during either 1976 and 1977, as discussed elsewhere in the section, 50 Class I line haul railroads, one Class II railroad and five Class I switching and terminal operations make up the sample. The Class II and switching and terminal railroads chosen are those with hump yards, which contain many of the noise producing sources which are affected by the proposed

Table 6-15

TOTAL COSTS OF NOISE ABATEMENT TECHNIQUES
($ IN MILLIONS)

	Capital Cost		Operating and Maintenance Costs	
	Res. Only	Res.+ Comm.	Res. Only	Res.+ Comm.
Retarders	33.4	40.1	0.72	0.87
Locomotive Load Cell Test Stands	13.65	14.0	1.04	1.05
Switch Engines	42.6	54.6	4.97	6.38

regulations and thus would incur a significant expense under regulation. The switching and terminal companies included are the Alton and Southern (ALS), the Belt Railway Company of Chicago (BRC), the Indiana Harbor Belt (IHB), the Terminal Railway Association of St. Louis (TRRA) and Union Railroad (URR).* The Youngstown & Southern (YS) is the Class II railroad. A complete list of the railroads and equipment included in the analysis appears in Table J-25. The number of retarders, load cell test sites and switch engines impacted by each regulation option and included in this analysis is presented in Table J-2 for each railroad.

Considerable care should be taken in analyzing the results of this analysis. This approach is best used to suggest the possibility that specific individual railroads may have difficulty financing noise abatement expenses. Since the same procedure and data base is used for each railroad, the results serve as a comparative guide among railroads as to which may be most affected or are in the weakest financial position. As a relative measurement technique, the results will indicate those which will be less affected by regulations or are financially stronger. However readers must be cautioned that no attempts were made to develop specific forecasts for individual firms or to analyze individual railroad conditions. Moreover, no attempt was made to integrate the analysis of the railroad industry as a whole (discussed elsewhere in this section) into the analysis of individual railroads. Despite these limitations, the methodology does provide an assessment of potential impacts of noise regulations on individual railroads.

Data Sources

A vast amount of data was culled from a number of different publications obtained primarily from the Interstate Commerce Commission and the Association of American Railroads. These sources are listed below:

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* Letters in parentheses are the railroads' uniform alpha codes.

Operating and Traffic Statistics

The principal source for Class I and II railroad operating and traffic statistics was the ICC's Transport Statistics in the United States and the ICC's QCS Reports (not published but available in the Public Documents Room at the ICC). The QCS reports provided detailed information on tonnages and revenues by STCC category for all freight commodities hauled by Class I railroads. In addition, detailed operation and traffic statistics for Class I and some Class II railroads were available from the AAR in its Operation and Traffic Statistics, O.S. Series No. 220.

The same data on operating and traffic statistics were available for Class I and II switching and terminal companies from the ICC. All of the operating and traffic statistics were contained in the R-1 or R-2, Annual Report filed by each railroad each year. A summary of commodities hauled (for Class II railroads) was included in the R-2 (Schedule 2602), whereas no corresponding table existed in the R-1 Annual Reports.

In 1978, the ICC changed its classification scheme so that Class I railroads were designated as those with operating revenues in excess of $50 million; Class II railroads had operating revenues greater than $10 million but less than $50 million. As a result, a number of the railroads (approximately 20) were reclassified as Class II railroads. In addition, many of the data reported were changed in format or level of aggregation. Finally, what had been Class II railroads became Class III railroads, with only a fraction of the data available in the R-3 Report. Thus, the 1978 data which were used in the current analysis represents the most current, consistent set of data available, but unfortunately exclude all Class III railroads.

Financial Data

The individual railroad financial data also were gathered from the R-1, R-2 and R-3 reports. The net worth data were taken from the comparative general balance sheet and represent total shareholder's equity. Net income was obtained from the income statement. Deferred taxes and equity in earnings of affiliates data appeared in the statement of changes in financial condition. The cash flow and net worth data were average over the 1973 to 1978 period, generating a single estimate. This "smoothing" technique reduced the prospect of choosing an unrepresentative base period from which the twenty-year projections were derived.

Employment Data

Employment data were obtained from two sources. The source of employment data for Class I railroads was an AAR report, *Rank of Class I Railroads* (by Employees for 1978). The ICC does not summarize employment data in a single source and does not require it to be reported in the R-1, *Annual Report*. However, the principal source of employment data for Class II railroads was the R-2, *Annual Report*. These employment figures by category of employment were summarized in Schedule 2401.

Costs of Regulatory Compliance

The costs for each of the noise abatement technologies have been discussed earlier. Specific unit capital costs and annual O&M costs were summarized in Table 6-14. These formed the basis for the cost impacts.

Regulatory Scenarios and Assumptions

Two regulatory scenarios were evaluated. In one, the impacts were computed under the assumption that the regulation applied to yards abutting only residential receiving property; the second assumed that all yards bordering residential/commerical receiving property were regulated. Within each of these scenarios, a high and a low impact were calculated. The high impact, in each case, assumed that the high price elasticity of demand obtained; the low impact used the low elasticity estimate. Additional assumptions are summarized below.

Residential Receiving Property

The annualized costs described in Table 6-15 were used to compute the impacts on all Class I and Class II railroads. Each hump yard was assumed to have one master retarder. Of these, 75 of the 124 were assumed to require the treatments listed in Table 6-14. Similarly, 141 of 189 locomotive load cell test stands require quieting in the residential option. Finally, 3,976 of the inventory of switch engines owned by each of the Class I and Class II railroads as reported by AAR required quieting.

Residential/Commerical Receiving Property

The method used to calculate the more severe impacts associated with regulating all those yards abutting residential or commerical property has inherent uncertainties. Ideally, one would like to know which of the 4169 railyards in the inventory actually do border residential or commerical property. However, the property line of railyards in the EPIC sample was used as a basis from which to extrapolate the total residential/commercial property affected. There was no way to precisely assign individual retarders, load cells or switch engines to owning railroads on this basis.

In order to develop some estimate of the impact of the noise abatement standards when applied to residential/commercial receiving property, it was decided simply to take the proportion of retarders (or load cells, or switch engines) in the option being considered relative to the total number, and scale all costs accordingly. An obvious problem with that approach is that railroads in more densely settled parts of the country, the East and the Midwest, may have a proportionately greater number of yards bordering residential or commercial property. Thus, the costs estimated for those railroads will be somewhat underestimated relative to railroads in less densely populated regions of the country.

Regulatory Schedule

The final source regulation requires compliance on January 15, 1984. To meet this effective date, the assumption was made that all capital equipment would be purchased, installed and put in use in 1983, except for those switch engines treated during the major overhaul cycle, as discussed above. The depreciation for capital equipment begins in the year in which equipment is put in use with investment tax credits generated at that time as well. It is further assumed that, once equipment is put in use, it will also generate operating and maintenance costs. Thus, for compliance at January 15, 1984, costs will be incurred prior to the effective date.

Economic Impact Analysis

In this section, the economic impacts of the railyard noise abatement regulations will be summarized. Individual impacts for 49 Class I and Class II railroads, and 14 Class I and II switching and terminal companies are presented in Appendix E. Only freight impacts are evaluated because, as was suggested earlier, the passenger component of the railroad industry is so small relative to all rail activity that passenger impacts are expected to be negligible. In the first round of the analysis with 1977 data Class III railroads (formerly Class II) were included. However, the update with 1978 foreclosed that analysis since few of the data were available. Some Class I and II railroads were excluded (e.g., the Canadian Pacific in Maine) because no financial data or no operating and traffic statistics were available. In this section, we have aggregated these railroads for analysis by Eastern, Southern and Western District Class I and II railroads, and separately, Class I and II switching and terminal companies.

Impact on Operating Costs

The present value of total capital costs (including replacement costs) are summarized in Table 6-16. Annualized total costs, capital costs and operating and maintenance costs are summarized in Tables 6-17 through 6-19,

Table 6-16

PRESENT VALUE TOTAL CAPITAL COSTS*
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
Eastern District	18142.4	20914.6
Western District	21839.9	20923.1
Southern District	7560.6	8366.9
U.S. Total	47542.9	50204.6
Switching & Terminal	2008.0	2392.5

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* NOTE: These totals are lower than the capital cost estimates shown in Table 6-1 for several reasons, including:

- Out of Service Costs are omitted here but included as Capital Costs in Table 6-1.
- Future capital outlays are discounted (lower) here, but not in Table 6-1.
- This analysis applies only to Class I and II railroads, a subset of the total industry.

Table 6-17

TOTAL ANNUALIZED COST
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
Eastern District	10127.2	12534.5
Western District	10234.1	12504.9
Southern District	2935.8	3592.7
U.S. Total	23297.1	28632.1
Switching & Terminal	1679.2	2117.0

Table 6-18

TOTAL ANNUALIZED CAPITAL COSTS
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
Eastern District	3202.6	3827.8
Western District	3280.3	3823.8
Southern District	1033.6	1218.7
U.S. Total	7516.5	8870.3
Switching & Terminal	443.2	546.4

Table 6-19

TOTAL ANNUAL OPERATING AND MAINTENANCE COSTS*
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
Eastern District	6924.7	8706.3
Western District	6953.9	8681.1
Southern District	1902.3	2373.8
U.S. Total	15780.9	19761.2
Switching & Terminal	1236.2	1570.5

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* NOTE: These totals are higher than the O & M cost estimates shown in Table 6-1 for several reasons, including:

- The effects of future inflation are reflected here but not in Table 6-1.
- Out of Service costs are included here. In Table 6-1, Out of Service costs are included with capital outlays.
- Replacement mufflers are included here but not in Table 6-1.

for Class I and II railroads in each of the three ICC districts and for Class I and II switching and terminal companies.* It is clear that the largest percentage of the abatement compliance costs will be borne by Class I and II railroads. Total annualized costs for switching and terminal companies will amount to only slightly more than 7 percent of total costs imposed on all Class I and II railroads. These costs will be passed through to the line haul railroads using the yards, however, and thus the additional impact on Class I or Class II line haul railroads will be small.

Total annualized capital costs as depicted in Table 6-18 are small compared with "retained funds"** as reported by the AAR. In 1978, retained funds were reported as 749.8 million.*** Total annualized capital costs for residential receiving property amounted to $7.5 million, or 1 percent of retained funds. However, because railroads have had to borrow approximately three times their retained funds in each of the last five years to finance all capital expenditures, one can assume that the entire cost of the noise abatement fixes will be financed, thus competing directly with funds needed for capital improvement expenditures.

Total annual expenditures on operating and maintenance costs are summarized in Table 6-19. Again, it is clear that switching and terminal companies' expenditures will amount to only a small fraction of the Class I and II railroads' expenditures, approximately 8 percent. Class I and II railroads' expenditures will amount to a very small proportion of total operating expenses, approximately .07 percent in the residential receiving property scenario and in the residential/commercial receiving property scenario. Thus, the total noise abatement costs appear to be a very small proportion of all capital and operating costs.

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*Note that these estimates differ significantly from those shown in Table 6-1. The differences are described in footnotes to the tables.

**Retained funds is the cash flow available to the railroads from which capital expenditures can be financed. Annual capital expenditures have been considerably larger than retained funds in recent years, reflecting heavy borrowing by railroads in financial markets.

***AAR, Yearbook of Railroad Facts, 1979 Edition, p. 21.

Impact on Prices

In order to calculate the impact of abatement compliance costs on prices, total costs in the preceding section were weighted by revenue ton-miles for each railroad relative to total ton-miles in the industry. Table E-5 of Appendix E is summarized in Table 6-20. For Class I and II railroads, the impact ranges from .0017 cents per ton-mile for Southern District railroads in the residential receiving property scenario to .0062 cents per ton-mile for Eastern District railroads in the residential/commercial receiving property scenario.

Average revenue per ton-mile is shown in Table 6-21 for each of the three ICC districts and for the U.S. total. For Eastern District railroads, the price impact may range from .17 percent to .21 percent. For Western District roads, the impact ranges between .09 and .12 percent of average revenue per ton-mile; while for Southern District roads, the range is between .08 and .09 percent.

Impact on Output

In order to compute the impact of abatement compliance on total revenue ton-miles, the percentage price increase must be multiplied by the price elasticity of demand times the base output (for small changes). Weighted average price elasticities of demand were calculated for each railroad in Table E-8 of Appendix E; these are summarized in Table 6-22. The average price elasticity ranges from .275 for Eastern District railroads to 1.128 for Western District railroads. The average for the U.S. ranges between .348 and 1.037.

The net decrease in revenue ton-miles, which is summarized in Table 6-23, primarily reflects the fact that Western and Eastern District railroads account for a larger share of total revenue ton-miles than the Southern District railroads. Under the high impact assumptions for residential/commercial receiving property, Western District shipments decrease by .13 percent or

Table 6-20

AVERAGE ANNUAL COST INCREASE PER TON-MILE
(in ¢ per ton-mile)

	Residential Receiving Property	Residential/Commercial Receiving Property
Eastern District	.00503	.00621
Western District	.00201	.00249
Southern District	.00173	.00211
U.S. Total	.00265	.00328

Table 6-21

AVERAGE REVENUE PER TON-MILE IN 1978
(in ¢ per ton-mile)

Eastern District	3.001
Western District	2.153
Southern District	2.230
U.S. Total	2.365

Table 6-22

WEIGHTED AVERAGE PRICE ELASTICITIES
(in percent)

	High	Low
Eastern District	.908	.275
Western District	1.128	.399
Southern District	.923	.284
U.S. Total	1.037	.348

Table 6-23

DECREASE IN OUTPUT
(in millions of revenue ton-miles)

	Residential Receiving Property		Residential/Commercial Receiving Property	
	Low	High	Low	High
Eastern District	90.6	338.5	118.4	420.8
Western District	183.3	536.1	223.8	655.6
Wouthern District	39.6	165.5	48.7	202.2
U.S. Total	313.5	1040.1	390.9	1278.6

655.6 million ton-miles. Eastern District shipments decline by 420.8 million ton-miles or .19 percent of their total, while Southern District shipments decline by only .09 percent or 202.2 million ton-miles. Impacts in the low calculations for both types of receiving property are considerably smaller, averaging only .04 percent of 313.5 million ton-miles in the least stringent regulatory option.

Impact on Employment

Employment impacts closely parallel changes in output (revenue ton-miles) because the output-labor ratio is assumed to be constant. Using the high impact computations for residential/commercial receiving property, total industry employment may fall by 635 jobs or less than .2 percent of total employment. These impacts are summarized in Table 6-24. Almost half of that decrease will occur in Eastern District railroads, and according to Table E-7 of Appendix E, 215 jobs, or about one-third of that decline, will occur at Conrail. Under the lower impact assumptions, only 192 jobs would be lost, of .04 percent of total 1978 employment.

These employment impacts are extremely small. In all likelihood, the required reductions in employment could be accomplished through normal attrition. (As current employees retire or quit voluntarily, the reductions could be accomplished with no layoffs.)

Financial Analysis/Impact Assessment

This section summarizes the net present value (NPV) analysis of future revenues and abatement expenses. (Definitions of terms, descriptions of the calculations, and the detailed output are found in Appendix J).

The computations were performed for each of 56 railroads for both the residential and residential/commercial regulatory options. Included in the analysis of the data are discussions of the following measures:

Table 6-24

NET DECREASE IN EMPLOYMENT
(Number of Persons)

	Residential Receiving Property		Residential/Commercial Receiving Property	
	Low	High	Low	High
Eastern District	91	327	113	402
Western District	86	251	105	306
Southern District	15	57	18	69
U.S. Total	192	635	236	777

- net worth or net investment
- net present value of future adjusted cash flows before abatement
- net present value of incremental abatement cash flows
- net present value of adjusted cash flows with abatement
- net present value of adjusted cash flows with abatement, as a percentage of net worth.

Existing Financial Difficulties

A number of railroads exhibit financial problems even before considering noise abatement regulations. The first group are those with negative net worth (net investment), which essentially implies that the equity base has been liquidated and the creditors of the firm are owners of the assets. This can arise from an accumulation of extraordinary and operating losses which are in excess of accumulated retained earnings and invested capital.

Six railroads meet this condition, as listed in Table J-22 of Appendix J. All but one, Central Vermont, also displayed negative future cash flows. In addition, the Clinchfield and the Georgia, which are included as part of the Seaboard Coast Line System, have zero net worth. These eight railroads will be omitted in most of the following analysis. Negative net worth is a meaningless concept in the net present value approach taken here, other than to indicate capital erosion, vulnerability to increased operating costs, or potential difficulty entering the capital markets for additional funds.

A number of additional railroads experienced negative adjusted cash flow on the average over the 1973-78 period (expenses exceeded revenue plus deferred taxes). The extrapolating employed here simply extends this negative average over the 20-year horizon, 1989-1999, thereby yielding negative net present value of future cash flows.

Table J-5 lists the present value of future adjusted cash flows before abatement for all 56 railroads, with negative values highlighted by an asterisk. Tables J-19 and J-20 list separately those railroads with positive and negative future adjusted cash flows, respectively. Three railroads show zero values - the Canadian Pacific in Maine, the Georgia and the Clinchfield. For the Canadian Pacific in Maine, operating deficits over 1973-78 were offset by "contributions from other companies" in revenues. An oppposite transaction occurred for the Georgia and the Clinchfield, in which excess revenues over expenses were transferred to other companies, resulting in zero net income.

Using the adjusted discounted cash flow method, future cash flows are less than zero for 15 railroads. Ten of these presently have positive net worth (some mix of equity and retained earnings), which could erode if operating losses continue. Among the six railroads with negative net worth, the Central Vermont improved dramatically in recent years, showing a positive average cash flow over the period. The other five roads with both negative net worth and negative future cash flows (Conrail, Grand Trunk Western, Missouri-Kansas-Texas, Northwestern Pacific, and the Youngstown and Southern) showed declining performance over the six-year period.

Three of the railroads in the negative earnings group are presently in Section 77 Trusteeship. These are the Boston and Maine; Chicago, Rock Island and Pacific; and Chicago, Milwaukee, St. Paul and Pacific. Trustees have been appointed to manage the assets of these railroads. They do have the power to restructure the debt of these firms, which could amount to consolidation and lengthening of outstanding bonds and other loans.

Those 10 roads which display negative future cash flows but still maintain an average positive net worth warrant further examination. In addition, there are 21 railroads whose adjusted future cash flows exceed net investment, resulting in a negative net present value before abatement. These are listed in Table J-24, and the net present value of future cash flows are highlighted in Table J-5 by an asterisk. This is an indication that additional costs placed on these roads could impose hardship. That is, in addition to the 8 railroads with an average negative or zero net worth position, 28 (eliminating the CP) show a negative net present value before considering abatement impacts.

It is interesting to note that some of these railroads which display negative net present values include the Atchison, Topeka and Santa Fe, Burlington Northern and Southern Pacific, all of whose parent companies, if not the railroads themselves, are generally considered financially healthy and should not be considered in a financially vulnerable position.

Abatement Cost Impacts - Residential Only Source Standards Option

The net present value of incremental abatement cash flows is the present value of cash outflows resulting from compliance at the assumed rates for inflation, interest (discount or reinvestment), income taxes and tax credits, adjusted for abatement-caused capital investment. The estimated costs of abatement are, of course, directly related to the number of identified noise sources owned by each railroad and their associated costs. Table J-13 presents the present value of these streams of future cash outlays by railroad, in total and by source.

The net present value of cash flows with abatement, the final column of Table J-13, adjusts net present value of future adjusted cash flows (Table J-5) by net present value of abatement cash flows. For the reasons outlined previously, the Georgia and the Clinchfield are eliminated from consideration along with those having a negative net worth. The 31 roads with negative net present value of adjusted cash flows after abatement are the same roads with negative cash flow before abatement and are listed separately in Table J-15. No railroad shifted from positive to negative NPV due to additional costs of abatement.

Those railroads with a positive NPV (17 in total) are shown in Table J-14. Of these 17 roads, only two (Detroit, Toledo and Shoreline and Duluth, Missabe and Iron Range) have future abatement-related flows as great as 10 percent of net worth.

In terms of the net present value of abatement outflows relative to net present value of cash inflows (adjusted) prior to regulation, only two exhibited outflows greater than 10 percent: Detroit, Toldeo and Shoreline (72%) and the Union Railroad (19%).

From the data gathering effort, 2 railroads were found not to be affected by the regulation, as no noise sources were identified for these railroads: Texas Mexican and Duluth Winnipeg and Pacific. Both of these exhibited a favorable net present value of adjusted cash flows before abatement.

In summary, those railroads which tend to indicate possible cash flow problems or inadequate capitalization prior to noise regulation would also continue to have problems after regulation. Those 17 with positive cash flows and capitalization would appear to be able to continue to operate without adverse consequences after the implementation of the noise standard.

The next step in the analysis considers those railroads whose NPV, although positive, may be sufficiently close to zero to present potential difficulty. One measure of "sufficiently close" is the ratio of NPV to net worth. For two railroads, the Detroit, Toledo, and Shoreline and the Duluth, Missabe and Iron Range (Table J-16), this ratio is greater than zero, but less than 10 percent. For 15 others, the ratio exceeds 10 percent. Included among these fifteen railroads, the ratio of NPV to NW is greater than 10 percent, but less than 100 percent, for 12 roads while 3 roads' ratios exceed 100 percent. These ratios are listed by railroad in Table J-17.

Two Class I switching and terminal companies and the one Class II road show decreasing abilities to bear additional operating or capital costs (Indiana Harbor Belt, Terminal Railroad Association of St. Louis and the Youngstown & Southern). The Indiana Harbor Belt and the Terminal Railroad Association of St. Louis have positive future cash flows, but the net present values of future cash flows both before and after abatement are negative. The Youngstown & Southern, a Class II railroad under the former classification, exhibits negative future cash flows before abatement, as well as a negative net worth. It is, of course, in the negative NPV position after abatement. It should be noted that no data were available to identify any ownership of switcher engines; thus, it is assumed that the YS has none and no regulatory costs for switchers are incurred.

A third switching and terminal company, the Belt Railroad of Chicago, has positive adjusted future cash flows and positive net investment. However, with net investment about 10 times as great as cash inflows, the firm shows a negative net present value before any regulation.

Many of the railroads displaying potentially troublesome financial difficulties with regulation, as categorized in Table J-15 (negative net present value of future cash flows with abatement), and Table J-22 (negative net worth), are subsidiaries of other roads, parts of larger railroad systems, or subsidiaries of other corporations. Thus, it is possible that the individual firm's financial position should not be analyzed independently, but instead considered as part of the overall organization of which the company is a part. Table 6-25 relates these firms to their parent. The railroads are grouped as follows:

1. Net investment less than or equal to zero.
2. Ratio of NPV to net worth less than zero but greater than -0.5.
3. Ratio of NPV to net worth positive, but less than 0.1.

While these choices are arbitrary, they serve to group railroads to permit some general conclusions.

Several reasonable explanations exist as to why firms might subsidize financially unhealthy subsidiaries of affiliates. Among these explanations are:

1. The railroads with NPV less than zero includes many which would appear healthy if depreciation were included in cash flow. These are also most of the group (13 or 17) whose ratio of NPV/NW is less than zero but greater than -0.5. This arbitrary assignment of values to the ratio facilitates a manageable review of those railroads which may show financial difficulty, but will continue unimpeded because of a healthy parent corporation.

2. Tax considerations--Circumstances unique to the firm, its parent or the industry may offer significant tax incentives to maintaining the operations of an apparently unprofitable or unhealthy subsidiary. Aspects of the tax law make this general statement particularly applicable to the railroad industry.

Table 6-25

RAILROAD-PARENT RELATIONSHIPS

Railroad	Parent
Negative or Zero Net Investment	
Central Vermont	Grand Trunk Corp., Canadian National Railway
Conrail	USRA
Grand Truck Western	Grand Trunk Corp., Canadian National Railway
Clinchfield	Seaboard Coast Lines
Georgia	Seaboard Coast Lines
Missouri-Kansas-Texas	Katy Industries
Northwestern & Pacific	Southern Pacific
Youngstown & Southern	Various
NPV/NW>-0.5	
Bangor & Aroostook	Independent
Boston & Maine	Bomaine
Canadian Pacific in Maine	Canadian Pacific
Detroit, Toledo & Ironton	Penn Central
Delaware & Hudson	Dereco-Norfolk & Western
Long Island	MTA of New York
Illinois Central Gulf	IC Industries
Illinois Terminal	Illinois Central Gulf and Norfolk & Western
Chicago, Milwaukee, St. Paul & Pacific	Independent
Chicago, Rock Island & Pacific	Independent
Chicago & Northwestern	Independent
Colorado & Southern	Burlington Northern
Fort Worth & Denver	Colorado & Southern (BN)
Western Pacific	Western Pacific Industries
Indiana Harbor Belt	Conrail
Terminal RR Assn. of St. Louis	Various
Youngstown & Southern	Various
Toledo, Peoria & Western	Atchison, Topeka & Sante Fe; Penn. Co.
Belt RR of Chicago	Various
0.1>NPV/NW>0	
Detroit, Toledo & Shoreline	Norfolk & Western and Grand Trunk Western
Duluth, Missabe & Iron Range	U.S. Steel

3. Nature of subsidiary operation--Many of the railroads examined here are not independent entities but instead are integral parts of a larger operation. Examples include: the Terminal Railroad Association of St. Louis and the Belt Railway of Chicago which are owned by groups of line-haul railroads and provide diverse and essential services to their owners in the respective cities. The Duluth, Missabe and Iron Range is an integral part of U.S. Steel's iron ore mining and transportation system in the upper Great Lakes. In these cases, it is difficult to analyze the railroad separately from the broader operation of which the railroad is a part.

4. Future potential--The parent may have expectations of eventually turning the unprofitable subsidiary into a profitable operation.

It remains possible that despite the additional costs of the regulation and its impact on the net worth of firms, other considerations operating both before and after the regulation, will induce the parent to continue to subsidize the operation. That is, additional costs will not endanger the individual road's operation.

Abatement Cost Impacts--Residential/Commercial Source Standards

This option represents a further restriction of the regulation analyzed above. Regulatory costs for Option 2 appear in Tables J-6, J-7, J-8; tax credits and depreciation off-sets appear in Tables J-11 and J-12; NPV for Option 2, in Table J-13 and summary Tables J-14 and J-15. Ratios developed under this option appear in Tables J-16, J-17, and J-18.

The absolute costs associated with this option are, as expected, greater, although the results are in general consistent with those of the residential only option. In addition, the railroad groupings are unchanged - no railroad moves to a different category as a result of the more stringent regulatory option.

Qualifying Observations

The effects of several crucial assumptions on the analysis should be reviewed.

—Inflation between 1980 and 2000 will average 6 percent per year.

—The opportunity cost of capital for all railroads is 10 percent.

—Investment tax credits have been taken in full (10%) in the year in which capital expenditures are made (capital expenditures are listed in Table J-8 and their related investment tax credits are listed in Table J-15).

—The complement of the marginal tax rate of 46 percent is used to convert before-tax costs (and thus outflows) of abatement for O&M, out-of-service, and depreciation (Tables J-9, J-10, and J-11).

Changes in these assumptions could result in regrouping of railroads using the net present value techniques. The effect of some changes are suggested below:

—An increase in the inflation rate will increase present values, and vice versa.

—An increase in the discount rate would decrease present values, and vice versa.

—Should limitations actually be placed on the amount of investment tax credit or should the proposed abatement equipment not be eligible for investment tax credits, no regrouping of railroads by NPV will occur. The investment tax credit is not significant with respect to the outflows it is assumed to offset. However, not all railroads may be able to use the full 10% in the year of outlay. Individual firm analysis could result in regrouping.

If the effective tax rate for individual firms is less than the assumed marginal rate, due to defererals, the net effect would be zero. That is, while an increase would occur in the outflows, an increase would simultaneously occur for inflows, assuming that the increase for deferred taxes is above the 1973-1977 average. If no offset occurs for deferrals and the real tax rate is below the 46% assumed, the after tax costs and outflows understated both before and after present value factors are applied. Furthermore, the depreciation inflow would likewise decrease. The tax rate is applied to operating costs to determine after tax cash outflows, applying a factor of (1-t) where t is the tax rate. For depreciation inflows the factor is t.

Conclusions

The preceding evaluation of the cost impacts of noise abatement regulations will be summarized below. The major conclusion is that on an industry-wide basis, even in the more stringent residential/commercial receiving property standards and with the high demand elasticities, the net reductions in revenue ton-miles and employment are small. If the demand for rail freight transportation services grows at all, the impacts of the noise regulations will be easily offset. The trend in rapidly escalating fuel prices and the concurrent noise standards for new trucks will lead to increased demand for rail services, thus, even the small impacts predicted here may be somewhat exaggerated.

Impacts on Rail Transportation Services

Price impacts are predicted to lie between .0027 cents per ton-mile and .0033 cents for Class I and II railroads. This represents a relative price increase ranging between .11 percent and .14 percent. Reductions in output are predicted to be very small, ranging between 314 and 1,279 million ton-miles for Class I and II railroads. These are .04 and .15 percent of total revenue ton-miles, respectively. Employment impacts are predicted to be extremely small, ranging between .04 and .16 percent of total industry employment, a reduction of between 192 and 777 jobs. Even these small changes may not be felt if normal worker attrition is used to pare the work force or if demand for rail freight services grows even marginally.

Results

1. A few railroads appear to be in serious financial difficulty, even before considering the costs of noise abatement. Six railroads show negative net work as of December 31, 1978, and ten additional railroads experienced a negative adjusted cash flow, on the average, over the 1973-1978 period. A total of 31 railroads show a net present value base of these adjusted cash flows and net worth data. While noise abatement costs will add to the financial burden of these railroads, serious problems are already present and cannot be attributed to the noise regulations.

2. In no instance was the present value of noise abatement costs greater than the difference between cash flow and net worth. Thus, noise regulations do not shift any railroad from a positive difference (between cash flow and net worth plus cost) to a negative difference.

Capital Requirements and Availability

Capital cost requirements were shown to be small relative to total capital expenditures by railroads in recent years. The present value of total capital costs, excluding out-of-service costs, was predicted to range between $47.5 million and $50.2 million*, which represent 6.3 and 6.7 percent respectively of "retained funds" or railroads' cash flow. While these amounts are not large, they do compete directly with requirements for capital expenditures on equipment and structures. Bescause the railroads' current capital expenditures are approximately three times retained funds, the increased capital requirements will be met through debt financing. Consequently, railroads may have added difficulties securing that financing as a result of their poor recent profitability. However, one cannot ascertain precisely how much these additional funds will cost the railroads or where they will be obtained.

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*Initial capital costs plus out-of-service costs for residential and commercial land uses is estimated to be $109.7 million ($90.7 million where only residential land use is considered).

Conclusions Concerning the Impact on Individual Railroads

The two analyses which this section contains, one an economic impact analysis and the other a financial impact analysis, come to the same conclusion, that the railroad industry will not be adversely affected by the costs of the noise abatement regulation of the railyards. In addition, none of the individual Class I or Class II railroads appears to be placed in any more adverse competitive position than the one in which they find themselves. For the five railroads in the worst financial shape (with negative net worth, negative cash flow and increasing annual deficits in the net income account), price, output and employment impacts are not large. Table 6-26 summarizes the impacts for three of these railroads. In each case, the predicted decrease in output is a tiny fraction of total output and employment impacts are likewise very small.

The financial analysis also identifies three railroads whose ratio of net present value with abatement costs to net worth is large and negative. These railroads could have more difficulty meeting abatement requirements than others and the resulting economic impact should be evaluated. In Table 6-27, the percent increase in price, and decrease in output and employment is summarized for each railroad. As can be seen, the impacts are extremely small.

Finally, for two railroads the ratio NPV/NW was greater than zero, but less than .1; for these railroads, the Detroit-Toledo Shoreline and the Duluth, Missabe and Iron Range, abatement cost impacts might be great enough to cause their competitive position to decrease sufficiently to lead to negative cash flows. However, according to the figures in Table 6-28, price, output and employment impacts are very small. The impact on the Detroit-Toledo Shoreline is greater than any of the railroads examined in detail thus far. However, even the impact on it is extremely small in reality.

Consequently, it appears fairly certain that the impacts resulting from the Noise Abatement regulation of railyards will not lead to a large impact, even on those railroads in the least financially sound condition. The cost

Table 6-26

PERFORMANCE OF RAILROADS WITH THE POOREST FINANCIAL CONDITION
(Residential Receiving Property)

	% Increase In Price	% Decrease In Output	% Decrease In Employment
Conrail	.21	.19	.06
Grand Trunk Western	.14	.21	.21
Missouri-Kansas-Texas	.11	.18	.06

Table 6-27

PERFORMANCE OF RAILROADS WITH NPV/NW < 0
(Residential Receiving Property)

	NPV/NW	% Increased In Price	% Decrease In Output	% Decrease in Employment
Chicago & Northwestern	-3.58	.10	.10	.04
Chicago Rock Island	-3.22	.16	.17	.04
Western Pacific	-2.98	.03	.01	.01

Table 6-28

PERFORMANCE OF RAILROADS WITH 0 < NPV/NW < .1
(Residential Receiving Property)

	% Increase In Price	% Decrease In Output	% Decrease In Employment
Detroit Toledo Shore Line	.32	.35	.35
Detroit Missabe Iron Range	.10	.09	.09

impacts are so small relative to total costs that even in the short run, before railroads can pass cost increases through, little damage would result from the increased costs. In the longer run, after costs are passed through, it is quite likely that the growth of rail transportation demand will offset even these modest increases.

SECTION 7

DOCKET ANALYSIS

INTRODUCTION

This docket analysis is the formal review of comments submitted by the public regarding the proposed Noise Emission Standards for Transportation; Interstate Rail Carriers. The proposed regulation was published in the Federal Register on April 17, 1979, with a public comment period of 45 days (until June 1, 1979). EPA extended the comment period by an additional 30 days, to July 2, 1979. During this period, three meetings were conducted by EPA for the purpose of information exchange with state and local officials covering the purpose, content, ramifications and other considerations relative to the proposed rule. The first meeting was held in Berkeley, California on May 23, 1979, the second in Springfield, Illinois on May 25, 1979 and the third in Miami Springs, Florida on May 26, 1979. Additional meetings involving data and information exchange were held with the Association of American Railroads in Washington, D.C. on May 15 and 18, 1979.

In addition to records of all of the above meetings, the official docket* includes all comments concerning the proposed regulation received by EPA during the formal public comment period. Two late comments that were received prior to the printing date are also included in the official docket. Those persons or organizations contributing comments have been grouped into the following categories: (1) state agencies, (2) city/county governments, (3) federal and foreign governments, (4) private citizens, (5) industry and (6) associations. A list of the specific contributors in each of these categories is provided in Table 7-1. Each contributor has been given an identification number corresponding to the order of receipt of its comments.

All comments published in the official docket have been reviewed; this section provides a summary of all substantive issues raised in these comments and the EPA response to those issues. The issues have been grouped into general categories to eliminate duplication of responses.

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*"Official Docket for Proposed Revision to Rail Carrier Noise Emission Regulation," EPA 550/9-79-208, Parts I and II, ONAC/EPA, Washington, D.C., July 1979.

Table 7-1

LISTING BY RESPONDENT CATEGORIES

State Agencies	Docket Number
California, State of, Department of Health Services	79-01-147
California, State of, Meeting with USEPA	79-01-049
Connecticut, State of, Transportation, Department of	79-01-045
Delaware, State of	79-01-114
Delaware, State of, Natural Resources and Environmental Control, Department of	79-01-047
Delaware, State of, Transportation, Department of	79-01-101
Florida, State of, Environmental Regulation, Department of	79-01-034/076
Illinois, State of	79-01-146
Illinois, State of, Environmental Protection Agency	79-01-109
Illinois, State of Environmental Protection Agency	79-01-144
Illinois, State of Meeting with USEPA	79-01-050
Kentucky, Commonwealth of, Environmental Protection, Bureau of (Jackson)	79-01-102
Kentucky, Commonwealth of, Environmental Protection, Bureau of (Roark)	79-01-015
Maryland, State of, Transportation, Department of	79-01-065
Minnesota, State of, Minnesota Pollution Control Agency	79-01-140

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

State Agencies	Docket Number
New Jersey, State of, Environmental Protection, Department of	79-01-160
New York, State of, Environmental Conservation, Department of	79-01-009
New York, State of, Executive Chamber	79-01-012
New York, State of, Transportation, Department of	79-01-130/148
Ohio, State of, Environmental Protection Agency	79-01-007
Oregon, State of, Public Utility, Commission of	79-01-054
Oregon, State of, Environmental Quality, Department of	79-01-036/113
Pennsylvania, Commonwealth of, Department of Transportation	79-01-017
South Carolina, State of	79-01-041
South Dakota, State of,	79-01-006
Texas, State of, Railroad Commission of Texas	79-01-103
Virginia, Commonwealth of,	79-01-116
Washington, State of, Ecology, Department of (Saunders)	79-01-058
Washington, State of, Ecology, Department of (Vogel)	79-01-061
Wyoming, State of,	79-01-003

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

City/County Governments	Docket Number
Alexandria, Virginia, City of,	79-01-108
Alhambra, California, City of,	79-01-141
Bellingham, Washington, City of,	79-01-052
Berkeley, California, City of,	79-01-008
Bloomington, Minnesota, City of,	79-01-082
Burton, Michigan, City of,	79-01-055
Chicago, Illinois, City of, Energy and Environmental Protection, Department of	79-01-057
Chicago, Illinois, City of, United States Environmental Protection Agency	79-01-091
Clinton, Iowa, City of,	79-01-001
Columbia Heights, Minnesota, City of,	79-01-143
Counties Research, Inc., National Association of,	79-01-062
Dade, Florida, County of,	79-01-162
Dallas, Texas, City of,	79-01-086
Denver, Colorado, City and County of,	79-01-004
Des Plaines, Illinois, City of,	79-01-011
Des Plaines, Illinois, City of,	79-01-083/984
The District of Columbia, Government of,	79-01-163
Dover, Delaware, City of,	79-01-046
Fridley, Minnesota, City of,	79-01-119
Henrico, Virginia, County of,	79-01-142

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

City/County Governments	Docket Number
Jacksonville, Florida, City of,	79-01-037
Kansas City, Missouri, City of, Health Department	79-01-023
Lincoln - Lancaster Health Department, County of,	79-01-069
Los Angeles, California, County of, Regional Planning, Department of,	79-01-020
Maumee, Ohio, City of,	79-01-038
Metropolitan Washington D.C., Government Council of,	79-01-033
Miami Springs, Florida, City of,	79-01-131
Miami Springs, Florida, City of,	79-01-145
Miami Springs, Florida, City of, Meeting with USEPA	79-01-051
Minneapolis, Minnesota, City of,	79-01-155
Montgomery Maryland, County of, Environmental Protection, Department of,	79-01-075
National League of Cities	79-01-138
Newark, New Jersey, City of, Police Department	79-01-021
Oak Ridge, Tennessee, City of,	79-01-156
San Bernardino, California, County of,	79-01-073
Seattle, Washington, County of,	79-01-040
Tucson, Arizona, City of,	79-01-018

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

Federal Governments	Docket Number
American Railroads, Association of, E.P.A. Meeting I	79-01-159
American Railroads, Association of, E.P.A. Meeting II	79-01-158
Commerce, Department of,	79-01-153
Environment, The Ministry of Canada	79-01-149
Environment Protection Agency, United States	79-01-115
Housing and Urban Development, United States Department of,	79-01-029
Housing and Urban Development, United States Department of,	79-01-122
Interior, The Department of	79-01-124
Interstate Commerce Commission	79-01-063
Seattle, Washington, City of, Housing and Urban Development, Department of	79-01-071
Transportation, Department of	79-01-152
Transportation Federal Highway Adnministration, United States Department of	79-01-025
United Nations Economic Commission for Europe	79-01-090
United States Environmental Protection Agency	79-01-085
Wage and Price Stability, Council on	79-01-136
Youths, Family and Health, Federal Ministry for Germany	79-01-139

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

Private Citizens	Docket Number
Barnes, William H., Private Citizen	79-01-016
Bewick, Jr., Robert D., Private Citizen	79-01-039
Birkner, David, Private Citizen	79-01-106
Bond, PhD., Elden A., Private Citizen	79-01-031
Born, Alice, Private Citizen	79-01-104
Bruns, Eber, Private Citizen	79-01-035
Burr, Roscoe C., Private Citizen	79-01-099
Cutshall, John E., Private Citizen	79-01-081
Daub, Albertina P., Private Citizen	79-01-032
Deets, H. C., Private Citizen	79-01-048
De Merrith, Ruth C., Private Citizen	79-01-055
Ferguson, Evelyn V., Private Citizen	79-01-093
Fraser, J. R., Private Citizen	79-01-092
Frendengerger, J. W., Private Citizen	79-01-028
Gjerding, Bradley, K., Private Citizen	79-01-072
Gjerding, D. L. C., Private Citizen	79-01-067
Hale, Dennis M., Private Citizen	79-01-087
Hara, Sheryn, Private Citizen	79-01-120
Holce, D. L., Private Citizen	79-01-094
Hubbard, Shaun, Private Citizen	79-01-105
Huston, Bill, Private Citizen	79-01-112

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

Private Citizens	Docket Number
Johnson, David, Private Citizen	79-01-014
Kirby, Wanda, Private Citizen	79-01-019
Kohner, Lynn, Private Citizen	79-01-066
Leeth, Beril F., Private Citizen	79-01-027
Lovelace, R., Private Citizen	79-01-079
Lyste, Sue, Private Citizen	79-01-026
Marcotte, Robert D., Private Citizen	79-01-002
Marr, Helen, Private Citizen	79-01-077
Meyers, Raymond W., Private Citizen	79-01-089
Moe, Osborn, Private Citizen	79-01-080
Moe, Osborn, Private Citizen	79-01-095
Moe, Osborn, Private Citizen	79-01-110
Moore, Jerome, Private Citizen	79-01-030
Palasco, John, Private Citizen	79-01-127
Pinkstaff, Private Citizen	79-01-070
Race, George, Private Citizen	79-01-097
Ramm, Virginia, Private Citizen	79-01-074
Rasmussen, Mrs. John R., Private Citizen	79-01-068
Rebane, John T., Private Citizen	79-01-117
Richard, Jerome, Private Citizen	79-01-096

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

Private Citizens	Docket Number
Ruane, Eugene B., Private Citizen	79-01-042
Seattle, Washington, Residents of, Private Citizen	79-01-118
Sternad, William A., Private Citizen	79-01-123
Sroufe, Evelyn, Private Citizen	79-01-128
Sunel, A. J., Private Citizen	79-01-024
Tretwold, Jane, Private Citizen	79-01-044
Tretwold, R., Private Citizen	79-01-043
Weaver, Mildred, Private Citizen	79-01-078
Wheeler, Walter L., Private Citizen	79-01-126
Whiteman, Glen W., Private Citizen	79-01-121
Whittle, Joe C., Private Citizen	79-01-088

Industry	Docket Number
Air-Conditioning and Refrigeration Institute	79-01-059
Bangor and Aroostook Railroad Company	79-01-064
Burlington Northern	79-01-150
Consolidated Rail Corporation	79-01-134
Delaware and Hudson Railway Company	79-01-056
Florida East Coast Railway	79-01-060
Ford Motor Company	79-01-161
General Electric Company	79-01-100

Table 7-1 LISTING BY RESPONDENT CATEGORIES (Continued)

Industry	Docket Number
Illinois Central Gulf Railroad	79-01-132
National Railroad Passenger Corp.	79-01-135
QIV, Incorporated	79-01-010
Saint Louis - San Francisco Railway Company	79-01-157
Track Specialities Co.	79-01-151
Turner Collie and Branden Inc.	79-01-154
Westinghouse Air Brake Division	79-01-013

Associations	Docket Number
Acoustical Society of America	79-01-164
American Railroads, Association of	79-01-137
Environmental Professionals, National Association of	79-01-022
Hearing, Educational Aid and Research Foundation, Inc.	79-01-098
Hearing, Educational Aid and Research Foundation, Inc.	79-01-107
Metro Clean Air Committee	79-01-129
Minnesota Speech and Hearing Association	79-01-053
Noise Control Officials, National Association of	79-01-125
Railway Labor Executives Association	79-01-133

CONCEPTUAL ISSUES

Property Line Standards

Six commenters (#58, 125, 129, 138, 144, 160*) objected to the adoption of property line standards on the basis of the consequent preemption of more stringent local standards. One commenter (#149) argued for the use of community noise standards rather than property line standards. Two commenters (#34, 140) remarked that only source standards should be adopted as EPA lacks the authority to enact property line standards. Four commenters (#126, 134, 146, 147) supported property line standards as it is these sound levels which affect public health and welfare. Two state agencies (#36, 116) supported receiving property line standards but suggested that flexibility be retained for taking the varying uses of receiving property into account.

Response:

EPA originally proposed a property line standard for railyards and three specific source standards.

The Agency has decided not to promulgate a receiving property line standard in this rulemaking. Rather, the Agency has chosen to regulate only specific important railyard noise sources at this time, and to delay rulemaking on a receiving property line standard pending further assessment and review of the extensive comments received on this facet of the proposed regulation. The U.S. Court of Appeals for the District of Columbia Circuit has agreed to this approach, and the Agency is charged with issuing a receiving property line standard by January 23, 1981. Upon finalization of property line standards, the Agency will, in the subsequent background document, more definitvely address individual comments to the docket on this issue.

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* Prefix to docket number, 79-01-, has been deleted in this analysis to conserve space.

L_{dn} Descriptor

Numerous commenters (#16, 25, 26, 36, 117, 129, 134, 135, 140, 144, 150, 152, 153, 157) expressed dissatifaction with the proposed L_{dn} standard. The most commonly expressed objection was that the standard did not adequately protect public health and welfare. Industry criticisms related to the discriminatory and inconsistent application of the standards to various noise sources and the nighttime penalty associated with the L_{dn} descriptor. Several commenters (#134, 135) objected to the use of the L_{dn} standard on the basis that non-regulated railroad equipment sources were included in the noise standard. Two private citizens (#30, 126), two state agencies (#102, 146) and one federal government source (#149) supported the L_{dn} standard as the best overall noise impact evaluation measure.

Response:

As a result of the substantial comment received with respect to the property line L_{dn} descriptor, the Agency believes that it should spend more time analyzing available data concerning the L_{dn} descriptor rather than issue a standard quickly. Therefore, it has chosen not to promulgate a general property line standard at this time. Instead it is issuing rules covering several railyard equipment sources and one railyard operation noise source. These standards are "not to exceed" average maximum A-weighted sound levels. The Agency plans to fully address the property line L_{dn} issue in the subsequent rulemaking action and will provide a more definitive response to the docket on the L_{dn} descriptor at that time.

Definition of Receiving Property

Two federal agencies (#25, 149) and two state agencies (#65, 146) requested clarification of the distinction between developed and undeveloped property. Another state agency (#58) suggested expansion of the definition to include undeveloped noise sensitive areas such as parks and camping areas.

Response:

The Agency's final source standards are applicable only to residential and commercial receiving property. The final regulation defines receiving property as any residential or commercial property that receives noise from railyard facility operations that is used for any of the purposes described in the following standard land use codes (ref. Standard Land Use Coding Manual, U.S. DOT/FHWA, reprinted March 1977): for residential land use -- 1, Residential; 651, Medical and other Health Services; 68, Educational Services; 691, Religious Activities; and 711, Cultural Activities; for commercial land use -- 53-59, Retail Trade; 61-64, Finance, Insurance, Real Estate, Personal, Business and Repair Services; 652-659, Legal and other Professional Services; 671, 672 and 673, Governmental Services; 692 and 699, Welfare, Charitable and other Miscellaneous Services; 712 and 719, Nature Exhibitions and other Cultural Activities; 721, 723, and 729, Entertainment, Public, and Other Public Assembly; and 74-79, Recreational, Resort, Park and other Cultural Activities. Given the extensive intermingling of land uses surrounding railyards, EPA believes that a regulation focusing on noise emissions received on residential and commercial property should provide some protection as well for other land uses.

Preemption

Numerous commenters* objected to the preemptive nature of the proposed railroad regulations. Their primary concern was that the proposed standards would result in increased community noise levels where more stringent local standards were preempted. Many urged EPA to explore avenues of recourse to have the preemption clause removed. Several commenters (#26, 31, 43) suggested that, at a minimum, local jurisdictions be allowed to impose a curfew on nighttime switching operations.

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* (#2, 14, 17, 26, 28, 31, 38, 40, 42, 43, 45, 46, 53, 57, 67, 70, 72, 82, 86, 98, 102, 114, 117, 120, 121, 131, 133, 136, 137, 138, 141, 142, 146, 147, 163)

Response:

Section 17 of the Noise Control Act of 1972, as interpreted by the U.S. Court of Appeals for the District of Columbia Circuit in Association of American Railroads v. Costle, 562 F.2d 1310 (August 23, 1977), requires that EPA set uniform national standards. The Act stipulates that standards preempt state and local statutes and ordinances for the equipment and facilities covered by the federal regulation. Further, the preemptive provisions of Section 17 do not apply until the effective date of this regulation, hence state and local governments can regulate railroad noise sources not covered by the Agency's December 31, 1975 regulation until the final regulation is effective. After that date, state and local governments may petition the Administrator of EPA for an exception allowing differing statutes and ordinances when they can show such differing regulation is not in conflict with the federal rule and is needed because of special local conditions. State and local authorities may continue to regulate those railroad noise sources which are not covered by the federal noise regulations.

The Agency understands the position of state and local governments on this issue. In developing the December 31, 1975 regulation, the Agency decided that railroad facility and equipment noise, other than that produced by locomotives and railcars, was best controlled by measures which did not require national uniformity of treatment. At that time, EPA opted to leave state and local authorities free to address site-specific problems on a case-by-case basis without unnecessary federal hindrance. Since EPA must now promulgate regulations of much broader scope as a result of the August 23, 1977 court order, the only recourse for interests that favor state and local control of railyards noise is through the federal legislative process.

Nondegradation

Fifteen commenters* objected to the regulation because it did not include a nondegradation clause. They contended that noise levels would increase in communities where state and local statutes and ordinances with more stringent standards currently exist and where noise levels are currently below the federal standards.

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* (#26, 31, 33, 36, 57, 58, 67, 69, 70, 72, 99, 125, 136, 147, 160)

Response:

EPA is required by court order to issue uniform national standards for railroad equipment and facility noise that comprehensively preempt state and local statutes and ordinances relating to the same equipment and facilities. The standards, proposed on April 17, 1979 in response to this court order, were developed in terms of typical or average situations. Consequently, the uniform national standards proposed were necessarily a compromise, only partially controlling railroad equipment and facility noise throughout the country. EPA realizes that there will be situations where existing noise levels at some railyards may be allowed to increase under these standards. The Agency will consider the nondegradation issue in developing its property line standards, to be issued in January 1981.

Stringency of Standards

Twenty-nine private citizens*, 20 city/county governments** and eight state agencies (#36, 102, 109, 114, 144, 146, 147, 148) objected to the regulation as proposed because the standards were not stringent enough. The most commonly expressed complaints were: the least common denominator standard which all railyards could meet was chosen, standards do nothing to protect public health and welfare, nighttime curfews should be imposed, residential and industrial zones have the same standards and recognition was not given to special local conditions and noise sensitive land uses. Five commenters (#5, 17, 75, 139, 153) criticized the regulation for its lack of consideration of special local conditions and noise sensitive land uses. Five commenters (#5, 17, 75, 139, 153) criticized the regulation for its lack of consideration of noise reductions and new or expanding facilities. Two associations (#129, 133) charged that the standards were not protective of worker and public health and welfare. A federal commenter (#149) urged that more stringent standards be adopted. Another federal commenter (#122) stated that HUD standards for low and moderate income housing may not be in compliance with the proposed levels. A state agency (#65) and an industry commenter (#150) indicated that the standards may be too stringent. Another industry source (#135) commented that the regulations were reasonable if amended to allow higher levels when temperatures dropped at night. Another commenter (#64) commended EPA for a reasonable approach to a complex problem. Two industry commenters (#102, 135) remarked that stringent standards were justified but only when necessary to protect residential property.

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*(26, 28, 30, 39, 42, 43, 44, 48, 67, 68, 70, 72, 74, 77, 78, 79, 80, 88, 89, 94, 96, 104, 105, 106, 110, 117, 118, 120, 128)

**(11, 18, 23, 33, 38, 40, 52, 62, 69, 73, 82, 86, 108, 119, 131, 137, 138, 143, 155, 156)

Response:

The Agency originally proposed a property line standard and three source specific standards. Public comments on the proposed receiving property line standard have made it clear that before a final rule of this nature is promulgated, there is a need for additional research and data collection. By delaying promulgation until January 1981, EPA will be in a position to adequately carry out the additional analysis necessary for the development of a final rule that is responsive to the public needs as expressed in the docket to the proposed regulation. Many of the docket comments refer to the stringency of property line standards and will be addressed as that regulation is developed.

In the current source standard rulemaking for active retarders, car coupling operations, locomotive load cell test stands and switcher locomotives, the Agency has given careful consideration to costs and economics as well as other factors.

Certain of the standards adopted to abate the noise from the above railroad noise sources are measured on receiving property (commercial or residential).

Thus these standards require the application of noise reduction technologies only in railyard situations where people may be impacted.

Land uses other than residential and commercial have not been considered in the formulation of these standards as only commercial and residential properties (refer to definition in regulation) are considered to be land use categories where large numbers of people are adversely affected by railyard noise emissions.

TECHNICAL ISSUES

Best Available Technology

Three industry sources (#134, 150, 157) commented that EPA is requiring more than "best available technology" in its proposed standards. They suggested a variance system be used whereby railroads could show that their facilities are fundamentally different due to technological infeasibility or physical impossiblility. One city/county government (#75) and one private citizen (#123) suggested that new innovative solutions be employed to reduce railroad noise. One association (#125), one city/county government (#33) and three state agencies (#113, 146, 160) proposed that EPA's definition of best available technology include various administrative controls which relate to the time, place or duration of railroad noise activities.

Response:

The final source regulations reflect the degree of noise reduction achievable through the application of the best available technologies or techniques, taking into account the cost of compliance. For this reason, the maximum allowable sound levels specified for each source standard vary according to the availability and cost of abatement technologies or techniques for the given source. For the purpose of determining the availability of technologies or techniques and costs of applying those technologies or techniques used in developing the final source regulations, the Agency considered the following: the use of local absorptive noise barriers around sources, reflective walls at the facility boundary, mufflers on switcher locomotives, and for car coupling, controlling the operation of rolling stock or its location relative to adjacent receiving property. Noise barriers can, for example, be constructed in close proximity to the source, at the railroad facility boundary, or both in combination, as appropriate to the situation. Because these are performance, not design standards, the railroads have total flexibility to apply whatever approaches are most attractive in terms of cost or other considerations, as long as the required noise levels are met.

Many railyards are already expected to be in compliance with most of the source standards, due in large part to the location of commercial and residential land use around railyards. Some rail carriers, however, may need to construct railyard facility boundary barriers to abate noise from only one or two of the sources impacting receiving property adjacent to the yard boundary.

Retarders

Industry sources (#134, 157) and the AAR (#137) disputed EPA's statements that barriers for retarders would be effective in meeting a property line standard because of retarder orientation with respect to the property line and because of difficulty due to closeness of trackage at group retarder sites. Three commenters (#137, 144, 150) stated that technology is not available to meet EPA's standards for retarders. Cited was the BN Northtown Yard which uses EPA recommended technology, where the proposed retarder A-weighted source standard levels of 90 dB were exceeded by 1.3 dB during tests. Two industry commenters (#103, 134) took exception to the use of releasable retarders because of the safety hazards associated with their use. Ductile iron shoes were discounted as an aid in reducing retarder noise because of short-term durability (#10, 134, 137). Three industry sources (#134, 150, 157) further disputed the qualification of spray lubrication systems for "best available technology." Cited against their use was the undesirable oil pollution run-off and the need to redesign some yards to provide additional retarder length to compensate for friction losses. Two commenters (#33, 160) supported the retarder noise standard.

Response:

The Agency pursued the retarder orientation issue by soliciting industry comment and supportive data regarding retarder orientation and installation requirements at hump classification yards. After carefully reviewing the available data the Agency does agree that barriers for group retarders would be either ineffective or installation would be inpractical in many instances. Consequently, the Agency has revised its retarder source standard to allow the industry both more flexibility in barrier arrangement at the master and group retarders and the use of facility boundary walls in the vicinity of noise sensitive receiving property.

Technology is available at reasonable costs for reducing the noise from active retarders. The Agency recognizes the fact that there will be variations in the retarder noise levels from one yard to another. The retarder squeals at Northtown during the tests cited were at levels slightly higher (2-3 dB) than typical levels at most yards. It is expected that individual railyards will measure their retarder noise levels to determine the amount of noise reduction required at each site. Barrier height and length requirements will be selected to bring the actual noise levels into compliance with the standard.

In the proposed regulation, the only case where replacement of fixed inert retarders by releasable units was considered necessary was to meet the proposed hump yard facility receiving property line standard. Since the promulgation of that standard has been deferred until January 23, 1981, more time is available to consider the safety hazards and other factors associated with releasable retarders.

Car Coupling

Three commenters (#134, 150, 157) argued that the 4 mph speed limit on car coupling could be attained only under ideal conditions. They contend that speeds of 6 or 8 mph are more reasonable alternatives to enforce. Conrail (#137) and AAR (#134) further argued that the 4 mph goal for car coupling on which EPA based its noise standards of 95 dB at 30 meters is not being achieved by the industry and that no known durable cushioning materials are available to reduce noise levels. Three state agencies (#58, 140, 160) commented that the proposed standard is not stringent enough in reducing car coupling noise levels. Ten commenters (#30, 58, 69, 102, 114, 125, 144, 147, 148, 160) recommended that the 4 mph exception provision be dropped from the regulation. They felt it would be easy for the railroads to control speeds during enforcement monitoring, thus taking advantage of the exception provision.

Response:

The proposed car coupling standard was 95 dB measured 30 meters from coupling incidents, with an exception provision for those couplings with sound levels greater than 95 dB for which the railroad could show that coupling occurred at speeds less than four miles per hour. This standard was based on the sound level associated with four mile per hour coupling, since the majority of railroads stated four miles per hour to be their operating rule, or recommended practice. There is substantial evidence, however, that many railroads do not, as a matter of course, comply with their own published operating rules or recommended practices. The data submitted to the docket by rail carriers indicate that more than sixty percent of car couplings occur at speeds greater than four miles per hour. Because EPA must presume that, in the presence of a federal rule, the railroads would have to comply with such a coupling speed limit, the Agency has assessed the potential adverse impacts of this rule on railroad operations. This assessment revealed some evidence that train movements could be adversely affected if railroads were to comply fully with the proposed rule on a nationwide basis. Consequently, the

Agency has made the final rule less stringent. The final standard for car coupling impact noise would generally restrict car coupling speeds to no greater than eight miles per hour. The standard of eight miles per hour is the maximum speed desirable to minimize freight damage.

The Agency believes that the standard can be met by the majority of railroads with little or no change in operations, thus avoiding further technology applications or additional costs. The measurement methodology has been refined to allow compliance measurements to take place at receiving property rather than 30 meters from the point of coupling. Further, at least 30 consecutive car coupling inpact sounds are required for a period of not less than 60 minutes nor more than 240 minutes. An exception provision has been defined so that the standard will not apply where the railcarrier demonstrates that the standard is exceeded when cars representative of those found to exceed the standard are coupled at similar locations at coupling speeds that do not exceed eight miles per hour.

EPA fully recognizes that the noise level generated at eight miles per hour is high. A standard reflecting lesser speeds would, however, result in some potentially serious operational slowdowns which could lead to national railroad system disruptions and high cost impact. The Agency encourages further industry attempts to reduce car coupling speed and in selective cases where communities are adversely affected by car impact noise it would appear that the railroad concerned might well be able to pay particular attention to car coupling speed without any unacceptable disruptive effect on its operations or on those of the rail system.

Refrigerator Cars

AAR (#137) and a state agency (#144) contended that the estimated A-weighted baseline noise levels that were used as a basis for setting mechanical refrigerator car noise levels are significantly below actual refrigerator car noise levels.

C-weighted sound levels were suggested as more appropriate. Three industry sources (#64, 134, 137), one state agency (#102) and the Department of Transportation (#152) expressed the view that the present noise levels of mechanical refrigerator cars already represent the use of best available technology so that any further reduction in noise levels to meet the proposed standard (78 dB at 7 meters) is not possible. Four commenters (#33, 102, 125, 160) suggested that EPA explore the feasibility of providing electric service directly to refrigerator-car cooling systems and of shutting down the diesel-engine power sources while cars are in yards. One industry commenter (#59) requested clarification as to what additional noise abatement techniques, if any, would be required to meet the proposed property line standard and also questioned the validity of "Noise Control Technology for Truck-Mounted Refrigerator Units." The Council on Wage and Price Stability (#136) questioned the appropriateness of a separate standard for refrigerator cars. One industry source (#64) proposed that the standard only be applied to new equipment. Other commenters suggested that the specification for the microphone location was unacceptably vague (#59), and that an amendment be made to the wording of the proposed Section 201.14 dealing with construction of railroad sidings for refrigerator cars.

Response:

At the time EPA proposed the mechanical refrigerator car source standard, the available data indicated that refrigerator cars would emit A-weighted sound levels averaging 63 dB at 100 feet. This level is an average of the noise from both the compressor side and the engine side at high and low throttle conditions. Substantial amounts of new noise data for refrigerator cars were received from the industry during the docket period. Based upon these additional new noise data, as well as the previous data, A-weighted baseline noise levels for refrigerator cars are estimated to average 67 dB at 100 feet. This is an increase of 4 dB above the Agency's previous determinations.

The Agency rejects industry assertions that no further noise reduction is achievable on refrigerator cars. Further noise reductions clearly are achievable by reducing the reverberant noise build-up in the engine compartment through use of sound absorptive foam and by blocking the external line-of-site to the engine from outside the refrigerator car.

The Agency has investigated controls for mechanical refrigerator car noise emissions levels but does not believe they should be addressed in this regulation. While further noise reduction in refrigerator cars is achievable, EPA has not yet completed its analysis to allow a decision on the regulatory level(s). In addition, it should be noted that the use of mechanical refrigerator cars by the railroad industry is declining. Their function is being replaced by containers on flat cars (COFC) and trailers on flat cars (TOFC), which were not addressed in the proposed rules. All of these factors as well as the docket responses will be addressed in determining how to regulate this source in the final receiving property line rulemaking.

Locomotive Load Cell Test Stands

One industry commenter (#132) stated that enclosed load cell test facilities presented problems because elaborate ventilation systems were required to keep the locomotive running. Another industry commmenter (#64) indicated that the proposed regulation was in conflict with previous regulation requiring load cell testing in clear field situations. The industry (#134) also commented that load cell test stands are generally located near repair facilities and that relocation of the test stands would increase requirements for both manpower and locomotive movements to and from the repair facilities, resulting in substantial costs, losses in productivity and a decrease in efficiency.

Response:

The abatement of locomotive load cell test stand noise was a part of the receiving property line standard in the proposed regulation. EPA believed that the noise from such operations could be reasonably dealt with by relocating locomotive load cell testing away from noise sensitive receiving areas close to the railroad facility boundary, or by enclosure of the test facility from which the noise was emitted.

After reviewing available abatement technologies and techniques, cost data and public comments, the Agency has modified its technology and cost assessment approach to reducing noise from locomotive load cell test operations. EPA cost and benefit studies show that total enclosure of test stands is generally less attractive than the use of 150 foot (length) by 25 foot (height) (45.7m x 6.1m) absorptive barrier walls around the facility and the locomotive being tested. The latter treatment completely eliminates the need for ventilation systems, and substitutes a much simpler structure.

Switcher Locomotives

AAR (#137), Conrail (#134), another industry commenter (#56) and the Department of Transportation (#152) commented that the muffler retrofit of switcher locomotives may not achieve the degree of noise reduction which EPA has estimated. It was stated that the degree of muffling is dependent on the throttle position and that mufflers are most effective at full throttle when it is desirable to silence exhaust noise. Several commenters (#56, 134) were concerned about the size of the exhaust pipes which are needed when mufflers are used. One commenter (#64) suggested that the muffler standards only be applicable to new equipment.

Four industry commenters (#56, 132, 134, 150) contended that relocation of idling locomotives is not feasible in some yards because of lack of space and manpower and, further, that in some yards relocation would result in no change in sound levels. One state agency (#14) supported the relocation provisions.

Two state agencies (#114, 144) and a private citizen (#87) suggested that the regulation include provision for engine shut-down because of the high annoyance factor involved with idling locomotives. Conrail (#134) and another industry commenter (#135) discussed some of the problems of shutting down diesel locomotives and stated that large expenditures were necessary for electrically powered heaters to maintain engine liquids at near operating temperatures. It was suggested that higher noise emissions be allowed in colder weather (#135).

Response:

EPA considered the industry comments in arriving at the final regulation, including those related to idling switcher locomotive relocation and shut down. The technology the Agency assumes the railroads will use in meeting the switcher locomotive noise emission limits is muffling of the engine noise. The Agency's original proposal required the retrofit of that part on the entire locomotive (road haul and switcher) fleet. EPA has chosen to include only the switcher locomotives at this time because of arguments by the industry that the retrofit costs for the whole fleet would be excessive and that it is difficult to isolate those road locomotives used in railyard duty.

Locomotive noise is of two types: moving point source noise as the locomotive is involved in switching operations, and stationary point source noise as the locomotive is parked but is allowed to remain idling and not involved in any active operations. This regulation establishes not-to-exceed noise standards for both types of switcher locomotive engine noise.

A review of the locomotive exhaust noise reduction data available to the Agency at this time indicates that only a small degree of noise reduction has been achieved at the lower throttle settings for locomotives used for switching operations. Operational data indicate that approximately half of the locomotives used as switchers are road type locomotives while the remainder are lower horsepower units designed specifically as switchers. Noise data for the two classes of machines show no reduction at idle for units designed as switchers and 1.5 dB reduction at 100 feet in the SD 40-2 road haul unit tested. At the highest throttle settings an average noise reduction of at least 4 dB was achieved for each class. Although many switcher operations are at low throttle settings where little reduction in levels is expected, the data clearly indicate that exhaust silencers will reduce the overall noise emissions and significantly so at the locomotive maximum noise levels.

The Agency does not intend that switcher locomotives be retrofitted except in those railyards where it is necessary. Therefore, the Agency has instituted a two part compliance procedure. For compliance purposes, the Agency requires the determination of the noise level at any residential or commercial receiving property measurement location. The A-weighted sound level at such locations from switcher locomotives, singly or in combination with the sound from other stationary or moving locomotives, may not exceed a maximum level. If this level is not exceeded, switchers at that yard need not be retrofitted. Additionally, EPA analysis indicates that locomotive retrofit will not be required for many railyards. If the noise level measured at any receiving property measurement location exceeds the specified level, then all switcher locomotives in that railyard must meet the noise standard. All switcher locomotives not complying with this standard will require muffler retrofitting or other equivalent technology to achieve the standard's level. Only switcher locomotives manufactured before December 31, 1979 will be subject to this switcher locomotive standard since all locomotives manufactured after that date must meet the final standards for locomotives promulgated on December 31, 1975.

Additionally, the Agency has amended the regulation to no longer require locomotives to be connected to a load cell when undergoing a stationary test for the idle throttle setting.

Measurement Methodology

Sixteen commenters* criticized the proposed measurement methodology contending that its extreme complexity would result in little, if any, enforcement by state and local jurisdictions. Five commenters (#114, 147, 148, 152, 160) suggested that Type 2 meters be allowed because Type 1 are costly and unavailable, and Type 2 are sufficiently accurate. Conrail (#134) argued that EPA's measurement criteria do not account for a wide variety of contingencies affecting measurement accuracy. Two city/county governments (#82, 162) and a state agency (#58) criticized the 24-hour measurement criterion because many jurisdictions lack the manpower or time to take such measurements. One association (#164) and a federal agency (#149, 152) commented that impulse meters should be required to measure impulse sounds such as coupling and retarder squeals. One commenter (#164) suggested that measurements were more accurate if made over a continuous period of at least one week. A federal commenter (#153) recommended deletion of Section 201.33(d)(2) and (e) dealing with "clear dominance as these sections are arbitrary, imprecise, incomplete and may create measuring ambiquities." AAR (#137) commented that the proposed measurement methodology would permit noise measurements to be taken two meters from residential dwelling surfaces, thereby including reflected noise in the meter readings and effectively reducing the proposed regulatory levels by an additional 3 dB - a factor not considered in the technology and cost analysis. Another industry commenter (#135) suggested that railyard noise be allowed to exceed the ambient level from other activities by up to 3 dB. A state agency (#147) stated that noise levels should be an energy average of 10 or more events, all within 10 dB of the maximum level observed. Another state agency (#58) questioned the wording in Section 201.26(a) and suggested that the standard not be exceeded any time after the throttle setting is established. They also questioned the microphone location requirements of Sections 201.25 and 201.33(b). A private citizen (#26) commented that the measurement technique could not be used in the situation where the receiving property was 50-100 feet above the source. A federal commenter (#25) suggested that the regulation wording be changed to refer to "The FHWA Highway Traffic Noise Prediction Method," FHWA-RD-77-108.

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*(#33, 34, 40, 42, 57, 58, 69, 82, 102, 114, 118, 125, 129, 140, 148, 160)

A federal agency (#152), two state agencies (#102, 147) and an association (#125) all supported the adoption of receiving property line standards with measurements at the property line. One state agency (#101) commented that a fixed distance standard was preferable. Two city/county governments (#143, 155) argued that receiving property line standards and measurement locations if adopted, would be impossible to enforce.

Response:

After thorough technical review of the proposed measurement methodology for the measurement of railroad noise, EPA has made a number of changes which it believes will reduce the associated complexity and costs without compromising the accuracy and reliability of the noise measurements.

The final regulation requires that the sound level meter or alternate sound level measurement system used for compliance determination must meet, as a minimum, all the requirements for a Type 1 instrument. Slow meter response is specified for the stationary locomotive and locomotive load cell test stand standards. All other standards specify the fast meter response characteristic. To ensure Type 1 performance, the manufacturer's instructions regarding mounting or orienting of the microphone and the positioning of the observer must be observed. Measurements may be made with a Type 2 instrument, with the measured levels reduced by the following amounts to account for possible instrument errors: 2 dB for car coupling and 4 dB for active retarders.

A reduction in the complexity of the measurement procedures has been achieved with the elimination of the procedures for determining clear dominance that appeared in Section 201.33. Since all noise measurements in this regulation now pertain to specific sources, the identification of railroad noise can be greatly simplified. The concept of clear dominance has been replaced by generally requiring visual identification of operating equipment and by requiring operating equipment sound levels to exceed non-operating levels by specified amounts.

A basic consideration in this rulemaking has been the appropriate location for the noise measurements and the attendant standard. The Agency's proposed source standards required noise measurements at a specified distance from the source. However, after further consideration and review of public comments, the establishment of source standards based in part on receiving property line noise levels was considered preferable to the originally proposed concept. This approach has particular appeal with respect to compliance measurement, enforceability and consistency with a final overall property line standard to be issued by January 23, 1981.

Two source standards specify not-to-exceed noise levels on receiving property; the other two source standards set specific trigger levels, also measured on receiving property. The use of noise measurements on receiving property should facilitate compliance measurements and eliminate possible safety hazards or interference with yard operations.

HEALTH AND WELFARE ISSUES

Health and Welfare Should Be A Primary Consideration

Seven commenters (#16, 30, 33, 54, 98, 114, 149) stressed that public health and welfare should be a primary consideration in the regulation of railroad noise. Two industry commenters (#134, 135) argued that annoyance, irritation and aggravation are not legal concepts upon which railroads should be regulated.

Response:

Section 17 of the Noise Control Act of 1972, which requires the EPA Administrator to publish regulations establishing noise emission limits on the facilities and equipment of interstate rail carriers, directs EPA to set standards that reflect the degree of noise reduction achievable through application of the best available technology taking into account the cost of compliance. Health and welfare considerations are useful to help establish goals against which to measure the effectiveness and cost of available technologies; however, Section 17 does not require that protection of public health and welfare serve as the basis for railraod noise standards. EPA gave some consideration to protection of the public health and welfare in deriving the proposed standards. The Agency calculated health and welfare benefits to be achieved by the regulation, but the final standards are based upon the best available technology taking into account the cost of compliance.

Need for Standards

Twenty-four private citizens* submitted complaints about noise from railroads. The most common complaints concerned car coupling and switching impacts, property damage, sleep disturbance and annoyance because of idling locomotives. One federal commenter (#63), two city/county governments (#20, 21) and one state agency (#41) support the regulation in its present form. Two city/county governments (#141, 145) and a federal agency (#139) stressed that the vibrations from railyards should be investigated. One state agency (#100) and an industry commenter (#157) stated that very few complaints are made about railroad noise.

Response:

In support of this rulemaking, EPA has attempted to determine noise levels both from individual sources and from the operation of the multiple sources which are combined into larger operations such as a classification yard. The understanding of how multiple sources interact to produce an overall noise level is essential since it is the combined noise of several sources that is heard in the community. Individual noise sources must also be understood since individual noise source treatment is usually the most effective method for reducing overall noise emissions. This regulation addresses four such individual noise sources.

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*(#16, 19, 24, 26, 31, 32, 35, 43, 44, 48, 55, 68, 70, 77, 78, 88, 92, 97, 99, 105, 121, 127, 128, 150)

The individual sources that have been identified as major railyard noise sources both by noise measurements and expressions of citizen annoyance are road haul and switcher locomotives; retarders; refrigerator cars; car coupling; load cells, repair facilities and locomotive service areas; wheel/rail interaction; and horns, bells, whistles and public address systems. Locomotives and railcars operated by interstate rail carriers were regulated by the December 31, 1975 rulemaking.

EPA has identified car coupling impacts and retarder screeching as two of the important contributors to noise from railyards. These sources, which produce impulsive noise involving extremely high sound levels that occur randomly for short durations over extended periods of time, are two of the four railyard noise sources addressed in this rulemaking. Switcher locomotives and locomotive load cell test stands, which produce nearly steady-state noise emissions from railyards, are also subject to the specific standards in this rulemaking.

EPA believes that technologies and techniques are available to abate the noise emissions from these sources at low to moderate costs. Residential and commercial land uses can be protected from noise levels exceeding the standard for active retarders by the application of absorptive noise barriers on both sides of master retarders and reflective barriers at the facility boundary line where necessary to reduce noise from group and tangential retarders. Similar protection can be provided to residential and commercial receiving property that is now subject to excessive noise from locomotive load cell test stands by employing absorptive barrier walls around the facility and locomotive undergoing test. Relief from excessive switcher locomotive noise can be obtained by retrofitting the locomotives with mufflers. The technologies suggested here are not required, but are available technologies that railroads may employ to reduce their railyard noise emissions to comply with the standards. Car coupling noise can be controlled by assuring that coupling occurs at speeds to no greater than eight miles per hour. The Agency believes that this standard can be met at almost all railyards with no change in operations, thus avoiding further technology applications or additional costs.

EPA has investigated controls for mechanical refrigerator car noise but does not believe that they should be addressed in this regulation. This noise source may be addressed further in the final receiving property line rulemaking due on January 23, 1981.

Omitted Sources

Nineteen commenters* remarked that horns, bells and whistles are major noise sources and thus should be regulated. Two commenters (#135, 147) argued that whistles, bells and other warning devices should be excluded from EPA's regulation. A state agency (#140) argued that maintenance-of-way equipment should be regulated. Two commenters (#63, 160) stated that compressors should be regulated. Three commenters (#59, 150, 152) urged that EPA clarify its apparent intent not to include refrigeration trailers and containers on flat cars in the final rule. An industry commenter (#135) requested that passenger trains and maintenance-of-way equipment not be regulated. A state agency (#147) commented that warning devices and maintenance equipment be specifically exempted so that state and local governments may regulate them.

Response:

Horns, bells, whistles and other warning devices produce a form of noise intended to be heard for safety reasons, instead of being an unwanted by-product of some activity. EPA does not intend, therefore, to set standards affecting these devices through this regulation.

Compressors, trailers on flat cars and containers on flat cars were not considered for source standards in the proposed regulation. These noise sources will be addressed in the final receiving property line rulemaking due on January 23, 1981.

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*(1, 27, 30, 34, 42, 45, 66, 81, 93, 112, 114, 125, 126, 135, 139, 140, 145, 150, 162)

The control of noise from locomotives and railcars is the principal noise abatement approach to the control of noise along the main lines. EPA could impose further limitations on the main line, but probably not without imposing major restrictions on the frequency of operations or the construction of barriers at an exorbitant cost. The Agency's position is, therefore, that the locomotive and railcar regulation limits contained in the previous regulation will be the only EPA restrictions on main line operations. The regulation does not apply to maintenance-of-way equipment. EPA has been unable to identify clearly the noise levels associated with the specific pieces of equipment or the possible combinations in which such equipment might be used. The regulation applies to the specified railyard equipment, as used in both freight and passenger train operations.

Modeling

Three commenters (#58, 125, 147) noted that modeling all non-railyard and through train noise impacts in order to determine background levels acceptable for proof of dominance is an unreasonable burden to place on local governments. Another commenter (#153) noted, however, that the modeling procedure is reasonable if carried out by competent personnel. Three commenters (#144, 150, 153) indicated that EPA in its model has overestimated the impacts of railroad noise and thus the benefits resulting from the regulation. One commenter (#58) questioned what criterion was used to determine the residential portion of the formula $L_{dn} = 22 + 10 \log_{10}$ (population density). They also commented that analysis should be made of the number of persons who will be exposed to increased noise levels. Conrail (#134) criticized the modeling techniques employed by EPA for failing to assess accurately the number of people and the extent to which they are affected. Another industry commenter (#150) recommended that it be allowed to use either EPA modeling techniques or the actual noise measurements to determine compliance. If not in compliance, they suggested they be allowed to study the individual yard and determine feasibility of various methods to reduce noise. A federal commenter (#153) questioned the origins of the constants "49.4" and "13.8" in equations on page 6-47 of the Background Document for the proposed regulation. They also recommended EPA perform further calculations of the effects on population at varying distances from railroads.

Response:

It has been suggested that EPA's railyard noise impact model may considerably overestimate the Equivalent Noise Impact (ENI) (a method to account for the extent and severity of noise impact) due to the use of an "average" population density around the yards which does not account for the lower densities which might be expected near the yard boundaries (i.e., in industrial and commercial areas) in the higher noise regions. EPA anticipated this potential problem in the proposed regulation and conducted analyses during the model development using available data to estimate the possible error. EPA counted the population around the 120 sample railyards on which the model is partly based. The population data obtained, in many cases, indicated very high local average population densities around large railyards where residential zones were mixed with industrial and commercial zones. If the model "squeezed" the people back into the residential areas rather than averaging, this would have the effect of reducing the area of impact with the given population, resulting in a higher population density and thus no net change in ENI. Furthermore, an analysis of ENI for actual population density distributions around seven hump yards (using data from the 1975 Railroad Regulation Background Document), as compared to the ENI results using an average density, indicated that, on the whole, if EPA did overestimate, it was on the order of less than five percent. At the same time, EPA's analysis tends to underestimate ENI, for example, in the use of only residential and commerical exposures rather than exposure of people in all land use environments, particularly in sensitive land uses, such as hospitals, schools, and churches, and due to the exclusion (because of lack of data) of many railyard noise sources from the impact analyses.

It was not possible within the data base and schedule limitations to develop a railyard simulation model that would determine accurately the location and patterns of iso-noise contours around the typical yard configurations. One of the basic data deficiencies involved the locations of sources within the component yards and consequently the separation distances between sources and operation areas. Thus, there was no way to assess with any accuracy the degree of overlap of noise patterns from different types of sources. However, the noise generation and propagation model for each type of source (within the input data limitations) did provide a reasonably accurate prediction of the noise patterns for an individual source. Additionally, the total length of the railyards in general was sufficiently great so that, for the idealized configuration used in the model, it could be assumed there was no overlap pattern between, for example, the switch engine operations in the receiving and departure yards. The areas more likely to receive impact from more than one source would be those near each end of the classification subyard.

The impact model was developed on the basis of individual source noise propagation patterns with no procedure in the model to account for proximity of sources, or to estimate joint impact from more than one source. Thus, the impact (ENI and PE) values for each source are computed separately, and the aggregate impact for each yard type (and the grand total from all yards) is obtained by summing over the sources. This allowed an evaluation of the contribution of each source to the estimated total impact. However, anticipating that there could be complex noise overlap patterns from various noise sources in railyards, EPA conducted two types of analyses to determine the potential error. Analytical models were used to calculate the variation in ENI as two separate point sources and two separate line sources were merged in various degrees of overlap (from two completely separated sources to a combined source of twice the noise energy of a single source). The results indicated that the ENI for two superimposed sources (of equal strength) was equal to the sum of the ENI from two completely separated sources. However, at intermediate degrees of overlap of two sources, the average difference between ENI for the separated sources vs. overlapped noise patterns was about 15 percent. Also, the railyard noise impact model was programmed to compare the results for selected yard types using the regular source groups (4 to 5 source groups at each type of yard) to the results of completely separating all types of sources (11 sources). The case of completely separated sources resulted in an 18 percent increase in total ENI compared to the four to five source group case. These analyses provide a reasonably good bound on the "error," which is less than 15 to 18 percent, since the length of the railyards precludes any significant overlapping of noise patterns from more than any two source operation areas.

It should also be noted that the object of the model is to provide only nominal estimates of ENI for various noise exposure scenarios in order to make relative comparisons of impact. Any change in the accuracy (or inaccuracy) of the input data and analytical model may change the baseline and study level results to the same degree, thus producing relative changes in impact quite similar in values to the less accurate model. Thus the model was developed on the basis of average or statistically expected values used in a deterministic procedure (as opposed to a stochastic model) to make relative comparisons.

In view of the very large diversity and scope of details regarding railyards and their operations, the severe limitations of the available data, and the time constraints imposed by the Federal Court ordered schedule for the development of the regulation, the railyard noise impact model was intended (as were the previous regulatory analysis models) only to provide a consistent procedure for estimating the magnitude of impact on the average at a national scale, and for making relative comparisons between an estimate of baseline impact and changes in impact as selected noise reductions were considered. It was not possible, and there was no intent, to use the model for providing absolutely accurate noise impact determinations, either for an individual yard, or for the total number of railyards. Additionally, the numbers of variables and assumptions required by the model made it impractical to conduct (within the data and time constraints) a composite uncertainty analysis to set bounds on the magnitude of impact with known confidence levels. Finally, there were no explicit legal requirements to base the regulation or noise standards on benefits (reductions in noise impact).

With regard to the question about the constants in the standard equations used to calculate L_{dn}, the values of 49.4 and 13.8 derive from the more general form of the equations:

$$L_{dn} = \text{SENEL} + 10 \log \frac{(NE_d + 10NE_n)}{24 \text{ hr.} \times 3600 \text{ sec/hr.}}$$

$$\text{where } 10 \log \frac{1}{24 \times 3600} = -49.4, \text{ and}$$

$$L_{dn} = L_{eq} (1 \text{ hr.}) + 10 \log \frac{(NH_d + 10NH_n)}{24 \text{ hr.}},$$

$$\text{where } 10 \log \frac{1}{24} = -13.8.$$

The EPA urban noise survey study from which the formula for background L_{dn} was obtained apparently used block level census data to determine the site specific local average population densities for correlation with the background noise level data at the selected measurement sites. Since the average local population densities in the railyard study areas were determined on a similar basis, it was reasonable to use them in the EPA formula to estimate the background levels near the railyards. In either case, even though the "true" residential population density fluctuates from census block to block or around the railyards, the important consideration is that a reasonably accurate average effect over each study area in question is obtained.

Other aspects of the railyard noise impact model are presented in detail in Section 5 of this background document.

COST AND ECONOMICS ISSUES

Cost of Compliance

Industry and government commenters criticized EPA's cost of compliance estimates as simply ignoring some important cost elements that will occur as a direct result of regulation and as grossly underestimating the level of increase of other cost factors.

Three industry commenters (#56, 134, 156) stated that the costs and complexities of land acquisition are substantially higher than EPA estimates and thus frequently make the alleviation of noise by the extension of railroad property lines through land purchase an economically unviable option. One commenter (#134) asserted that the acquisition of "buffer" land as a noise control alternative discriminates against railroads operating in the northeast corridors where prices are exceptionally high and undeveloped land is scarce.

The comments of four industry representatives critized EPA's estimates of noise abatement cost for the retarder noise source. One commenter (#150) stated that EPA's estimates do not "adequately" reflect the costs of releasable inert retarders, barriers for group and master retarders and spray systems at retarders. Barriers, it was asserted, will typically cost twice the EPA estimate. One commenter (#134) indicated that EPA's cost for absorptive barriers of $75 per linear foot is unrealistically low and that current day costs are closer to $150 to $200 per linear foot. One commenter (#134) concurred that the costs and impacts of barriers were not assessed correctly and additionally asserted that annual operation and maintenance costs were underestimated. Commenter #137 asserted that clearance problems exist at approximately one-half of the retarder locations requiring (a) track and retarder relocation, (b) rewiring of retarders and track switches, (c) extra downtime and (d) purchase of additional real estate to maintain existing car capacity. Two industry commenters (#134, 150) as well as the Department of Transportation (#152) criticized EPA's treatment of out-of-service time as a no-cost item, stating that such costs are significant and should be evaluated.

The EPA-estimated costs of locomotive modification were similarly criticized by three commenters (#134, 64, 157) as being far too low. The latter indicated that the real cost required to retrofit mufflers is roughly 500 percent of that estimated by EPA.

Three industry commenters (#64, 150, 157) argued that the costs of regulatory compliance for refrigerator cars are substantially higher than EPA estimates. The first two commenters estimated real costs as being twice those estimated by EPA while the latter commenter (#157) estimated the true cost differential as approaching 700 percent. The Department of Transportation (#152) criticized EPA for failing to give due consideration to out-of-service costs during installation of noise attentuating equipment on refrigerator cars.

EPA's estimate for enclosing load test cells was criticized as being unrealistically low by two industry commenters (#134, 150). The latter indicated that actual costs were five times the $90,000 level estimated by EPA. The criticism of locomotive load cell test stand barrier costs mirrored the criticisms expressed about the costing of retarder noise barriers mentioned above.

The Department of Transportation (#152) expressed disagreement with EPA's assertion that proposed car coupling standards impose no extra costs, but instead simply "codify existing practice." DOT information suggests that 70 percent of all couplings occur at speeds above 4 miles per hour.

One commenter (#137) took issue with EPA cost estimates in several additional ways. EPA estimated a zero cost for shutting down idling locomotives. This commenter points out that diesel engines are damaged when started and stopped frequently, especially in cold weather. Start-up takes time and results in attendant labor and maintenance cost increases that are not insignificant. EPA's cost estimate for noise measurement activities (labor only) of $500 to $2,000 per yard was less than one-half the $4,500 per yard expenditure estimated for such activities by this commenter. In addition, this commenter estimated the annualized costs of the regulation at four times the level of the EPA estimate.

One industry commenter (#134) argues that many operational impacts attributable to yard modifications are not readily quantifiable. These include:

(1) delays in traffic due to rehandling (multiple switching)
(2) increased per diem and transportation costs due to less efficient handling and added train miles (out of route)
(3) reduced car utilization
(4) deterioration of service
(5) erosion of traffic and revenues.

Response:

Based upon industry and state/local comments concerning the rationale and costing methodologies for provisions aimed at abatement of railroad yard noise levels, EPA has reevaluated the data and analytical approaches used in determining the proposed rules. This reevaluation has led to changes in individual standards tailored to meet the concerns expressed in docket submissions. The costs of compliance have been reestimated taking cognizance of industry cost estimates and criticisms. In order to meet the fiscal concerns of industry, yet at the same time achieve some noise emission reductions, the Agency considered options wherein noise abatement from railyards would only be required in yards where current noise levels adversely impact noise sensitive receiving property in the vicinity, such as residential and commercial receiving property. Cost estimates have been reexamined for each railroad noise source. In regard to retarders, additional EPA review has indicated that barrier costs of $100 to $150 per linear foot represent the "best" cost range to use for regulatory purposes. The final regulatory approach negates the need for placing absorptive barriers around every active retarder. The total number of barriers needed for abatement is greatly reduced since the railroad need only install barriers where they are needed and will be most effective, rather than at each retarder.

locations on residential or commercial receiving property, which is also used for the locomotive load cell test stand noise source (at an estimated cost of $260 to $325 per linear foot for barriers) in lieu of full enclosure, decreases industry cost while optimizing benefits accruing to receiving properties.

EPA has chosen to promulgate a switcher locomotive noise standard which affects only those locomotives identified by the industry and the ICC by name and model as dedicated to yard service and built before December 31, 1979. The Agency does not intend that switcher locomotives be retrofitted except in those railyards where noise levels as measured from applicable receiving property exceed a specified standard. This action substantially decreases the potential regulatory costs to industry. Unit costs for the switcher locomotive standard have been revised to include hardware, labor and out-of-service costs.

The car coupling noise proposal was originally based on the sound level associated with 4 mph couplings, since the majority of railroads stated 4 mph to be their operating rule or recommended practice. There is substantial evidence, however, that these railroads do not comply with their own published rules or operating recommendations. Because we must presume that, in the presence of a Federal rule, the railroads would now comply with such a coupling speed limit, the Agency has reassessed the potential adverse impact of this rule on the railroads. Since there is some evidence that train movements would be adversely affected resulting in high costs to the industry if railcarriers were to comply fully with the rule on a nationwide basis, the Agency has made the final rule much less stringent. The final rule for car coupling impact noise would generally restrict car coupling speeds to no greater than 8 miles per hour. An exception is provided so that the standard will not apply where the railcarrier demonstrates that the standard is exceeded when cars representative of those found to exceed the standard are coupled at similar locations at coupling speeds that do not exceed eight miles per hour.

EPA has elected not to promulgate at this time the type of source standards [illegible] the refrigerator cars, partially because of their declining truck-mounted (trailer) refrigerator units on flat cars (TOFC), which were not addressed by EPA in the proposed rules. Further, the Agency was not able to fully evaluate the potential for more significant noise reduction through technology applications at this time.

Economic Impact

EPA estimated that the general impact of the capital requirement for regulatory compliance would be minimal since sufficient capital would be available. Two industry commenters (#137, 134) strongly disagreed with this EPA analysis and asserted the potential of severe impacts resulting from the inability of many railroads to generate needed funds. Several industry commenters (#100, 132) warned that the high costs of compliance will necessarily depress the ability of railroads to make other essential capital investments and continue important capital programs. One industry commenter (#100) concluded that an "inevitable loss of revenues and traffic will result that in turn will prompt a further decline in the long suffering domestic railroad industry." Amplified support of this assertion was expressed by industry commenters (#84, 132) who pointed out that the industry's high price elasticity of demand will result in a substantial loss of business to truckers and other competitors as the costs of regulation raise railroad prices. In addition, one commenter (#137) argued that the Council on Wage and Price Stability would not allow the railroads to fully recover the costs of compliance because requested rate increases would necessarily exceed inflation guidelines.

Five commenters (#84, 106, 131, 137, 150) concluded that the curtailment or elimination of nighttime operations would have a much more substantial impact than EPA estimated. They argued that the imposition of a day-night standard for railroads would restrict all rail operations. Disruptions would result in many cases in operational delays and a reputation as an unreliable carrier. The loss of productivity resulting from the underutilization of

noise control operation.

One industry commenter (#134), additionally expressed concern that EPA should consider more carefully the economic impact of the regulations on Conrail's employees and customers. Special attention, it was argued, should be paid to Conrail's unique financial position and need for operating subsidies.

One commenter (#161), an industry shipper, stated that the regulations will prompt both an increase in the price railroads charge shippers and a major deterioration in the quality of railroad service. The service that railroads offer shippers will, as a result, become far less cost competitive.

A private citizen (#74), expressed concern that compliance with the regulation would be extremely hard to monitor, thus impairing its effectiveness.

Response:

EPA has estimated that under the residential and commercial receiving property standard concept, capital expenditures of approximately $110 million industry-wide would be required for regulatory compliance. This outlay, approximately 3 percent of total industry capital expenditures in 1978, is fairly large and one might expect that some companies may encounter some difficulty in securing necessary financing. However, such problems if they do arise, should not be accompanied by an "inevitable loss of railway traffic and revenue." EPA analyses have shown that the proposed regulation will have little impact on the demand for rail freight transportation services. While the noise regulations will increase railroads' costs, similar regulations with their associated compliance costs presently affect new, medium and heavy duty trucks used by the trucking industry. Consequently, a shift among competing modes as a result of this regulation is unlikely. If conditions such as fuel shortages continue to worsen, the demand for railroad services may actually increase as additional truck freight would be diverted to the more fuel efficient rails, thus further mitigating any cost effects of these railroad noise regulations. EPA analysis suggests that Conrail's costs will rise no more than .3 percent of total capital plus operating costs. EPA estimates that any employment reductions prompted by noise regulations would be accomplished through normal attrition.

These and other cost and economic impact issues are discussed in considerable detail in Section 6 of this background document.

Cost/Effectiveness

Four industry commenters (#134, 135, 154, 157) argued that the costs associated with the proposed regulation are not justified by the alleged benefits, and that EPA should attempt to maximize the cost/benefit ratio (#134, 157) and should offer some evidence that rail operations adversely affect the public health and welfare. Two commenters (#132, 152) noted that EPA should perform a detailed analysis of the effect of moving from a 70 dB to a 65 dB property-line standard for hump yards. One industry commenter (#135) suggested that exemptions be allowed in individual situations where the costs of full compliance are not warranted by the benefits obtained.

Response:

EPA believes that the final regulatory proposals are cost effective. Regulations are structured so as to abate on only noise sensitive receiving property. Consequently, costs are incurred only where benefits are to be gained. The Agency has identified an outdoor L_{dn} value of 55 dB as the noise level protective of public health and welfare with an adequate margin of safety. It is estimated by EPA that, currently, between 6.5 and 10 million people in the United States are exposed to day-night average railyard noise in excess of this protective level. Compliance with the final source standards will result in approximately a 10% to 15% reduction in impact, considering both extent and severity.

OTHER ISSUES

Need for Federal Enforcement Program

Conrail (#134) and another industry commenter ([illegible]) remarked that uniform national regulations and federal enforcement schemes are necessary to avoid numerous conflicting local regulations. Three city/county governments (#5, 75, 137) and four state agencies (#54, 116, 160) commented that financial support was needed for training, consulting personnel and equipment and legal advice. Five state agencies (#7, 34, 101, 147, 160) and four city/county governments (#23, 46, 62, 131) remarked that there would be little enforcement unless EPA was prepared to enforce its own regulations because of state and local manpower and time constraints.

Response:

The U.S. Court of Appeals for the District of Columbia Circuit held in Association of American Railroads v. Costle, 562 F.2d 1310 (August 23, 1979) that uniform national regulation of railroad equipment and facility noise was mandated by Section 17 of the Noise Control Act of 1972. EPA is responding to that mandate initially by promulgating these source regulations.

This regulation may result in some enforcement and implementation burdens on state and local agencies. The Noise Control Act places primary enforcement responsibility with the Federal Railroad Administration (FRA) of the Department of Transportation (DOT). Specifically, Section 17 of the Act directs the Secretary of DOT to promulgate regulations to ensure compliance with the EPA railroad noise standards. In addition, Section 17 directs the Secretary of DOT to carry out such regulations through the use of his powers and duties of enforcement and inspection authorized by the Safety Appliance Act, the Interstate Commerce Act, and the Department of Transportation Act.

The FRA has indicated to EPA that it will promulgate compliance regulations and will conduct investigations to determine compliance, utilizing the FRA enforcement authorities and limited enforcement resources.

EPA believes that the FRA has adequate authority under the Noise Control Act to enforce these regulations, and that, while EPA has some concurrent authority to enforce, the Act clearly places the primary responsibility for enforcement with FRA. Because of federal resource constraints, however, EPA anticipates that the major enforcement activity will need to be conducted by state and local agencies if the regulation is to be effective. EPA has made every effort to design these regulations in a manner which will facilitate the adoption and enforcement of identical regulations by state and local governments.

Need for Land Use Planning Provisions

An industry commenter (#135) urged that future develpment of land adjacent to railyards be restricted to uses compatible wih the noise generated from the railyard. A state agency (#101) commented that he federal government should not be involved in land use. Three state agencies(#147, 148, 160), one city/county government (#33) and an association (#123 urged that railroads be required to provide noise contours to local government showing current and future noise impact zones to encourage compatible land us planning.

Response:

The need for land use provisions is an issue which the Agency believes is more properly addressed under the receiving property [illegible] of the regulation, which will be promulgated by January 23, 1981.

Need for Public Participation

Three city/county governments ([illegible]), one state agency ([illegible]), and one private citizen ([illegible]) commented that EPA had not allowed adequate public participation and urged that EPA seek a further extension of the date for final promulgation of the regulation. An association ([illegible]) remarked that EPA should have consulted with railroad labor officials before issuing the regulation.

Response:

EPA initially established a [illegible]-day public comment period for the proposed rule. However, in response to a request from the AAR, the Agency, on May [illegible], [illegible], granted a [illegible] day extension to the public comment period.

To stimulate maximum participation from all public sectors, EPA made direct mailings to over 1700 selected organizations and individuals, including each railroad and other potentially affected members of the rail industry, all members of Congress, state and local governments, labor organizations, public interest groups, news media and private citizens selected from ONAC's mailing list. Included in each of the 1700-plus information packages was one of eight specially prepared cover letters designed to highlight those aspects of the proposed rule the Agency anticipated would be of greatest interest to the recipient. Also included were a copy of the Act, the Court decision, Fact Sheets, anticipated questions and answers and several other documents written specifically for public participation.

A press release was also included in the mailing packages or sent separately (as indicated by timing) so that most recipients, including the news media, had the information within one day of the appearance of the proposed regulation in the Federal Register. The press release was also sent to major wire services and a limited number of selected journalists by the EPA Press Office. Advance copies of all documents were sent to each EPA regional office and the National Association of Noise Control Officials in the week immediately preceding publication.

In addition to the direct mailing, a number of briefings were given immediately prior to, and immediately subsequent to publication in the Federal Register. These briefings were given to:

- Staff of Senate Appropriations Subcommittee (April 17, 1978)
- Federal Railroad Administration (April 24, 1978)
- National Conference on Noise Control Engineering (April 30, 1978)
- Representatives of State, County and Municipal Officials Organizations (May 2, 1978)
- Representatives of Principal Railway Labor Unions (May 7, 1978)
- State of California (May 24, 1978)
- State of Illinois (May 25, 1978)
- City of Miami Springs, Florida (May 26, 1978)

As a result of this extensive public participation effort, EPA received 159 written comments from all sectors solicited about this regulatory action. EPA believes that sufficient public comment was received on the proposed rule to delineate all possible substantive issues. This extensive public comment has been taken into account in developing the final rule. The schedule set by the Federal Court did not permit further public participation.

Diversity in Railyards

Six commenters (#42, 59, 64, 114, 150, 152) were concerned that EPA had not adequately considered the variations in railyards, including size, unique topographic features, noise levels, seasonal variations and surrounding land uses.

Response:

There are more than 4,000 railroad yards in the U.S. Therefore, it was not practical nor possible to conduct a site-specific analysis of each facility. Instead, the Agency has separated facilities into categories to facilitate the analysis. These categories are hump yards and flat yards, the latter category including classification/industrial yards and small industrial yards. EPA subsequently estimated the impact of various noise control technology and technique applications on the basis of a "typical" yard of each type modeled from the data. The rail industry has recommended that we make the regulations considerably less stringent in order to accommodate the "non-typical" yard(s) where noise control may be difficult. By the same token, there will be yards where the costs will be considerably less than estimated, and state and local governments have urged more stringent regulations. The Agency has attempted to establish noise emission levels for the "typical case" in order to arrive at uniform national standards as required by the Noise Control Act and the Federal Court's interpretation of the Act.

Lead Time

Three commenters (#42, 114, 144) urged that standards codifying existing practice (car coupling) be effective immediately. Four other commenters (#30, 45, 75, 147) questioned the necessity for the long implementation dates. An industry commenter (#150) remarked that only proposed yards not yet in the design stage for one year be required to be designed using the proposed modeling techniques. Another industry commenter (#100) requested that EPA monitor the effectiveness of the proposed 1982 standards prior to imposition of more stringent standards. Conrail (#134) stated that the lead times were too short; hump yards take one to three years each to modify, retrofitting switchers will take 3.3 years, suppliers cannot provide the requisite number of mufflers, and problems of shop capacity and insufficient skilled labor will prevent them from meeting the proposed timetable.

Response:

It is the Agency's intent to provide for a minimum period of three years (36 months) for the industry to comply with this rulemaking for source standards, as is consistent with the Agency's general policy. However, an amendment to the Noise Control Act currently under consideration requires that no final regulation issued under Section 17 be made effective earlier than four years (48 months) after publication. The congressional intent is to provide an additional 12 months compliance period for Congressional review of the final rule and a study by the Federal Railroad Administration. Thus, the Congress would have the opportunity to act to change the EPA rule during that 12-month period prior to the industry having to undertake compliance actions that would involve financial expenditures. It is anticipated that a similar compliance period will be provided in any property line standard.

Miscellaneous

An association (#[illegible]) made a number of definitional and technical comments to the regulation. They suggested that abbreviations and symbol usage be taken from ANSI Y10.11-1979 to avoid confusion, and that definitions be presented in dictionary format. The word "fast" should be inserted throughout in connection with maximum sound level, and "equivalent" should be replaced by "average." They commented that the text be written with full words rather than symbols, including decibel. It was suggested that "A-weighted dB/decibel" be deleted and be replaced by "A-weighted sound level of xx decibels." They also stated the "average" should be used each time in connection with the term L_{dn}, and that it should be explained that the standard represents an upper limit not to be exceeded, clarifying that it need not be increased to conform. A state agency (#160) questioned which regulation would prevail on railroad property when compressers and motor carriers are so located. One commenter (#153) noted that there is inconsistency in the definition of "clearly dominant sound." Another commenter (#112) asked whether a railyard included those with a single spur siding. Another commenter (#152) stated that "special purpose equipment" should not include residences on yard property. One commenter (#30) asked that "railroad facility boundary" be expanded to one-half mile past the last yard tracks. Conrail (#134) offered the following comments: in definitions (u), "Day-Night Sound Level," and (x), "Adjusted Measured Sound Level," there should be no provision for a day-night distinction; definitions (r), "Component Sounds from Railroad Facility Operations," and (s), "Component Sounds from Nonrailroad Facility Operations," are meaningless technologically unless there is sufficient integrity in monitoring equipment. Another commenter (#30) suggested that only the noise sources to which the rule is to be applied should be listed in the definitions. One commenter (#133) noted that definitions (aa), "Through Trains," and (cc), "Mainline Operations," when combined, result in ambiguity. Another commenter (#132) stated that EPA's definition of "through trains" was not broad enough. Another commenter (#77) suggested that definition (ee), "Residential Dwelling Measurement Surface" be revised to "...means a connected set of surfaces that are parallel to the real estate property line and are located at the property line provided that there is a residential dwelling on the premises."

Response:

EPA has revised the abbreviations and symbols to bring them into agreement with currently accepted practice. The concept of clear dominance has been replaced by generally requiring visual identification of operating equipment and operating equipment and sound levels to exceed nonoperating levels by specified criteria. Other specific comments regarding definitions have been taken into account in developing this final rule. A number of definitional problems will be resolved when the Agency fully addresses the property line standard.

APPENDIX A
NOISE MEASUREMENT METHODOLOGY

The revised Railroad Noise Emission Standards set noise level limits at 30 meters from individual noise sources, as well as on receiving property for selected sources and operations. In addition, measurements on railroad property are permitted to establish "probable compliance". The noise measurement methodology at these sets of locations is described in Subpart C of Part 201, "Measurement Criteria for Railroad Equipment", which is attached to this appendix.

Noise Measurement at 30 Meters From Specific Railroad Noise Sources

Revised Section 201.22 specifies the use of a Type 1 sound level meter, but permits use of a Type 2 instrument by adjusting the measured noise levels to account for the possible measurement inaccuracies that might result using such an instrument.

The titles of Sections 201.23 and 201.24 have been revised for clarity and to relate them to a 30 meter measurement distance. The criteria and measurement procedures incorporated in these sections have not been changed. Thus, the methodology for noise measurements at 30 meters has not been significantly revised from that in the original regulation.

Noise Measurements on Receiving Property

Sections 201.25, 201.26 and 201.27 are new and relate to the measurement methodology on receiving property adjacent to the railyard. Section 201.25 details criteria with regard to weather conditions and the selection of the proper location for the measurement microphone. The section prohibits measurement locations in the vicinity of vertical surfaces to eliminate problems resulting from reflection. However, measurements are permitted as close as two (2) meters from the exterior wall of a residential or commercial structure.

The procedures for receiving property measurements of retarder and car coupling impact noise are specified in Section 201.26. Except for requiring that measurements of car coupling impacts be obtained at a distance of at least 30 meters from the centerline of the nearest track on which car coupling occurs, the measurement procedures for retarders and car coupling impacts are identical. These procedures call for the measurement of each retarder or car coupling impact sound that occurs during a period of at least one hour and not more than four hours (note that each retarder or car coupling impact sound measured must be at least 10 dB above the noise level observed immediately before the specific sound). The maximum A-weighted sound levels (fast) of at least 30 consecutive sounds are measured during this period. Using this sample of maximum sound levels, first the average maximum sound level is determined, and then the adjusted average maximum sound level is determined from Table 2. The adjustment is based upon the number of measurements occurring during the measurement period, normalized to a 0 dB adjustment when there is one retarder or car coupling impact occurring per minute. The adjusted average maximum A-weighted sound level for either retarders or car coupling impacts is compared with the appropriate standard to determine compliance.

Measurement of the noise of locomotive load cell test stands and stationary locomotives on receiving property, in order to determine the applicability of the 30 meter standards for these sources, is described in Section 201.27. Since these sources are mostly steady-state in nature, the noise measure specified in the section is the L_{90} noise level. The measurement procedure involves measuring consecutive values of the A-weighted sound level at 10 second (or less) intervals for at least 15 minutes and until at least 100 measurements are obtained and then determining the L_{90} noise level for this sample.

As an assessment of whether the measured L_{90} is valid (i.e., whether or not the L_{90} is in fact due to a mostly steady-state noise source), 100 samples are taken, from which the L_{10} and L_{99} noise levels are determined as well. If the difference between the L_{10} and L_{99} noise levels is less than 4 dB, the value of L_{90} is considered to be validated.

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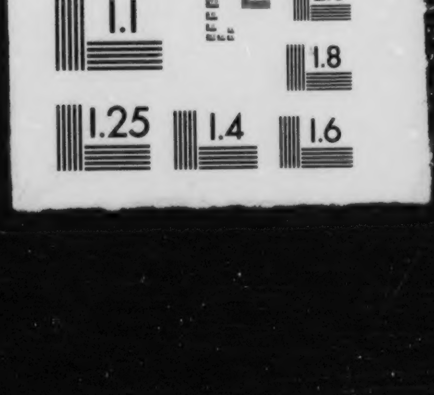

When the L_{90} is validated, procedures are described in Section 201.27 (C) for localizing the noise source and selecting the correct value of L_{90} when more than one of the sources (locomotive load cell test stand and stationary switcher locomotive) is present. These procedures call for the use of an L_{90} which is 3 dB below that measured when both sources are in operation, however, the actual L_{90} is used if the locomotive load cell test stand is the primary contributor to the measured L_{90}. The procedures also require that the measured L_{90} be more than 5 dB above the L_{90} that would occur at the same location if the noise sources in operation were not present. If any of the test site weather conditions and background noise criteria for measurement at a 30 meter distance of the noise from a locomotive load cell test stand cannot be met, an alternative standard at 120 meters is applicable.

Noise Measurements on Railroad Property

Section 201.28 permits the measurement of the noise of retarders, car coupling impacts, locomotive load cell test stands and stationary locomotives on railroad property if the measurement location is between the source and receiving property, and the measurement location is not better shielded from the noise source than would be the case if the measurement location were at the receiving property. The selected measurement location on railroad property should be in the general vicinity of the receiving property measurement location, so that if measured noise levels at this location are less than or equal to the appropriate source standard, the source standards would not be exceeded if measurements were to be taken at the receiving property.

SUBPART C - MEASUREMENT CRITERIA

In Subpart C §§201.20, 201.22 and the titles of §§201.23 and 201.24 are revised, and §§201.25, 201.26, 201.27 and 201.28 are added to read as follows:

§201.20 Applicability and Purpose

The following criteria are applicable to and contain the necessary parameters and procedures for the measurement of the noise emission levels prescribed in the standards of Subpart B of this part. These criteria are specified in order to further clarify and define such standards. Equivalent measurement procedures may be used for establishing compliance with these regulations. Any equivalent measurement procedure, under any circumstances, shall not result in a more stringent noise control requirement than those specified in this regulation using the measurement procedures in Subpart C.

§201.22 Measurement Instrumentation

(a) A sound level meter or alternate sound level measurement system that meets, as a minimum, all the requirements of American National Standard S1.4--1971[1] for a Type 1 (or S1A) instrument must be used with the "fast" or "slow" meter response characteristic as specified in Subpart B. To insure Type 1 response, the manufacturer's instructions regarding mounting or orienting of the microphone, and positioning of the observer must be observed. In the event that a Type 1 (or S1A) instrument is not available for determining non-compliance with this regulation, the measurements may be made with a Type 2 (or S2A), but with the measured levels reduced by the following amount to account for possible measurement instrument errors pertaining to specific measurements and sources:

Table 1: Sound Level Corrections When Using a Type 2 (or S2A) Instrument

Measurement Section	Source	Amount of Correction to be Subtracted from Measured Level (dB)
201.24	Locomotives	0 dB
	Rail Cars	0 dB
	Locomotive Load Cell Test Stand	0 dB
201.26	Retarder	4 dB
	Car Coupling	2 dB
201.27	Locomotive Load Cell Test Stand	0 dB
	Stationary Locomotive	0 dB

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[1] American National Standards are available from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

(b) A microphone windscreen and an acoustic calibrator of the coupler type must be used as recommended by: (1) the manufacturer of the sound level meter or (2) the manufacturer of the microphone. The choice of both devices must be based on ensuring that Type 1 performance is maintained for frequencies below 10,000 Hz.

Revised the title of § 201.23 to read as follows:

§ 201.23 Test Site, weather conditions and background noise criteria for measurement at a 30 meter (100 feet) distance of the noise from locomotive and rail car operations and locomotive load cell test stands.

Revised the title of § 201.24 to read as follows:

§ 201.24 Procedures for measurement at a 30 meter (100 feet) distance of the noise from locomotive and rail car operations and locomotive load cell test stands.

§ 201.25 Measurement location and weather conditions for measurement on receiving property of the noise of retarders, car coupling, locomotive load cell test stands, and stationary locomotives.

(a) Measurements shall be conducted only at receiving property measurement locations.

(b) Measurement locations on receiving property shall be selected such that no substantially vertical plane surface, other than a residential unit wall or facility boundary noise barrier, that exceeds 1.2 meters (4 feet) in height is located within 10 meters (33.3 feet) of the microphone and that no exterior wall of a residential structure is located within 2.0 meters (6.6 feet) of the microphone. If the residential structure is a farm home, measurements shall be made at any location from 2.0 to 10.0 meters (6.6 to 33.3 feet) from any exterior wall.

(c) No measurement may be made when the average wind velocity during the period of measurement exceeds 19.3 km/hr (12 mph) or when the maximum wind gust velocity exceeds 32.2 km/hr (20 mph).

(d) No measurement may be taken when precipitation, e.g., rain, snow, sleet, or hail, is occurring.

§201.26 Procedures for the measurement on receiving property of retarder and car coupling noise.

(a) Retarders

(1) Microphone: The microphone must be located on the receiving property and positioned at a height between 1.2 and 1.5 meters (4 and 5 feet) above the ground. The microphone must be positioned with respect to the equipment in accordance with the manufacturers' recommendations for Type 1 performance. No person may stand between the microphone and the equipment being measured or be otherwise positioned relative to the microphone at variance with the manufacturers' recommendations for Type 1 performance.

(2) Data: The maximum A-weighted sound levels (FAST) for every retarder sound observed during the measurement period must be read from the indicator and recorded. At least 30 consecutive retarder sounds must be measured. The measurement period must be at least 60 minutes and not more than 240 minutes.

(3) Adjusted average maximum A-weighted sound level: The energy average level for the measured retarder sounds must be calculated to determine the value of the average maximum A-weighted sound level ($L_{ave\ max}$). This value is then adjusted by adding the adjustment (C) from Table 2 appropriate to the number of measurements divided by the duration of the measurement period (n/T), to obtain the adjusted average maximum A-weighted sound level ($L_{adj\ ave\ max}$) for retarders.

(b) Car coupling impact

(1) Microphone: The microphone must be located on the receiving property and at a distance of at least 30 meters (100 feet) from the centerline of the nearest track on which car coupling occurs and its sound is measured (that is, either the microphone is located at least 30 meters (100 feet) from the nearest track on which couplings occur, or all sounds resulting from car coupling impacts that occur on tracks with centerlines located less than 30 meters (100 feet) from the microphone are disregarded). The microphone shall be positioned at a height between 1.2 and 1.5 meters (4 and 5 feet) above the ground, and it must be positioned with respect to the equipment in accordance with the manufacturers' recommendations for Type 1 performance. No person may stand between the microphone and the equipment being measured or be otherwise positioned relative to the microphone at variance with the manufacturers' recommendations for Type 1 performance.

(2) Data: The maximum A-weighted sound levels (FAST) for every car-coupling impact sound observed during the measurement period must be read from the indicator and recorded. At least 30 consecutive car coupling impact sounds must be measured. The measurement period must be at least 60 minutes and not more than 240 minutes, and must be reported.

(3) Adjusted average maximum A-weighted sound level: The energy average level for the measured car coupling sounds is calculated to determine the average maximum sound level ($L_{ave\ max}$). It is then adjusted by adding the adjustment (C) from Table 2 appropriate to the number of measurements divided by the duration of the measurement period (n/T), to obtain the adjusted average maximum A-weighted sound level ($L_{adj\ ave\ max}$) for car coupling impacts.

§201.27 Procedures for determining applicability of the locomotive load cell test stand standard and switcher locomotive standard by noise measurement on a receiving property

Table 2

ADJUSTMENT TO $L_{ave\ max}$ TO OBTAIN $L_{adj\ ave\ max}$ FOR RETARDERS AND CAR COUPLING IMPACTS*

$\frac{n}{T} = \frac{\text{number of measurements}}{\text{measurement duration (min)}}$	C = Adjustment in dB
0.111 to 0.141	-9
0.142 to 0.178	-8
0.179 to 0.224	-7
0.225 to 0.282	-6
0.283 to 0.355	-5
0.356 to 0.447	-4
0.448 to 0.562	-3
0.563 to 0.708	-2
0.709 to 0.891	-1
0.892 to 1.122	0
1.123 to 1.413	+1
1.414 to 1.778	+2
1.779 to 2.239	+3
2.240 to 2.818	+4
2.819 to 3.548	+5
3.549 to 4.467	+6

*$L_{adj\ ave\ max} = L_{ave\ max} + C$ in dB.

Values in Table 2 were calculated from [$C = 10 \log \frac{n}{T}$] with intervals selected to round off values to the nearest whole decibel. The table may be extended or interpolated to finer interval gradations by using this defining equation.

(a) Microphone: The microphone must be located at a receiving property measurement location and must be positioned at a height between 1.2 and 1.5 meters (4 and 5 feet) above the ground. Its position with respect to the equipment must be in accordance with the manufacturers' recommendations for Type 1 performance. No person may stand between the microphone and the equipment being measured or be otherwise positioned relative to the microphone at variance to the manufacturers' recommendations for Type 1 performance.

(b) Data: When there is evidence that at least one of these two types of nearly steady state sound sources is affecting the noise environment, the following measurements must be made. The purpose of these measurements is to determine the A-weighted L_{90} statistical sound level, which is to be used as described in subparagraph (c) below to determine the applicability of the source standards. Before this determination can be made, the measured L_{90} is to be "validated" by comparing the measured L_{10} and L_{99} statistical sound levels. If the difference between these levels is sufficiently small (4 dB or less), the source(s) being measured is considered to be a nearly steady state source.

Data shall be collected by measuring the instantaneous A-weighted sound level (FAST) at a rate of at least once each 10 seconds for a measurement period of at least 15 minutes and until 100 measurements are obtained. The data may be taken manually by direct reading of the indicator at 10 second intervals (± 1 second), or by attaching a statistical analyzer, graphic level recorder, or other equivalent device to the sound level meter for a more continuous recording of the instantaneous sound level.

The data shall be analyzed to determine the levels exceeded 99%, 90% and 10% of the time, i.e., L_{99}, L_{90} and L_{10}, respectively. The value of L_{90} is considered a valid measure of the A-weighted sound level for the standards in 201.11, §201.12 and §201.16 only if the difference between L_{10} and L_{99} has a value of 4 dB or less. If a measured value of L_{90} is not valid for this purpose, measurements may be taken over a longer period to attempt to improve the certainty of the measurement and to validate L_{90}. If L_{90} is valid and is less than the level in applicable standards for these source types, the sources are in compliance. If the measured value of L_{90} is valid and exceeds the initial 65 dB requirement for any of the source types that appear to be affecting the noise environments, the evaluation according to the following subparagraph (c) is required.

(c) Determination of Applicability of the Standard When L_{90} is Validated and is in Excess of One or More of the Source Standards:

The following procedures must be used to determine the compliance of the various source types when L_{90} is validated and in excess of one or more of the applicable standards.

(1) The principal direction of the nearly steady-state sound at the measurement location must be determined, if possible, by listening to the sound and localizing its apparent source(s). If the observer is clearly convinced by this localization process that the sound emanates only from one or both of these two sources, then:

(i) If only stationary locomotive(s), including at least one switcher locomotive, are present, the value of L_{90} is the value of the A-weighted sound level to be used in determining if the 65 dB requirement is exeeded and compliance with the standards in 201.11(c) and 201.12(c) is necessary.

(ii) If only a locomotive load cell test stand and the locomotive being tested are present and operating, the value of L_{90} is the value of the A-weighted sound level to be used in determining applicability of the standard in §201.16.

(iii) If a locomotive load cell test stand(s) and the locomotive being tested are present and operating with stationary locomotive(s), including at least one switcher locomotive, the value L_{90} minus 3 dB is the value of the A-weighted sound level to be used in determining applicability of the standards in §201.11(c), §201.12(c) and §201.16. This paragraph (iii) does not apply to measurements less than 120 meters (400 feet) from a locomotive load cell test stand, conducted when measurements at 30 meters (100 feet) cannot be made due to site conditions specified in §201.23(a).

(iv) If a locomotive load cell test stand(s) and the locomotive being tested are present and operating, and a stationary locomotive(s) is present, and if the nearly steady-state sound level is observed to change by 10 dB, coincident with evidence of a change in operation of the locomotive load cell test stand but without apparent change in the location of stationary locomotives, another measurement of L_{90} must be made in accordance with (b) above. If this additional measure of L_{90} is validated and differs from the initial measure of L_{90} by an absolute value of 10 dB or more, then the higher value of L_{90} is the value of the A-weighted sound level to be used in determining applicability of the standard in §201.16.

(2) In order to accomplish the comparison demonstration of (3) below, when one or more source types is found not to be in compliance with the applicable standard(s), documentation of noise source information shall be necessary. This will include, but not be limited to, the approximate location of all sources of each source type present and the microphone position on a diagram of the particular railroad facility, and the distances between the microphone location and each of the sources must be estimated and reported. Additionally, if other rail or non-rail noise sources are detected, they must be identified and similarly reported.

(3) If it can be demonstrated that the validated L_{90} is less than 5 dB greater than any L_{90} measured at the same receiving property location when the source types that were operating during the initial measurement(s) are either turned off or moved, such that they can no longer be detected, the initial value(s) of L_{90} must not be used for

determining applicability to the standards. This demonstration must be made at a time of day comparable to that of the initial measurements and when all other conditions are acoustically similar to those reported in (2) above.

§201.28 Testing by railroad to determine probable compliance with the standard

(a) To determine whether it is probably complying with the regulation, and therefore whether it should institute noise abatement, a railroad may take measurements on its own property at locations that:

(1) are between the source and receiving property

(2) derive no greater benefit from shielding and other noise reduction features than does the receiving property; and

(3) otherwise meet the requirements of §201.25.

(b) Measurements made for this purpose should be in accordance with the appropriate procedures in §201.26 or §201.27. If the resulting level is less than the level stated in the standard, then there is probably compliance with the standard.

(c) This procedure is set forth to assist the railroad in devising its compliance plan, not as a substantive requirement of the regulation.

APPENDIX B

NOISE SOURCE ABATEMENT COST ESTIMATES

Presented in this appendix are descriptions of specific methods and data sources used in deriving cost estimates for several of the noise source abatement procedures contained in this study.

Active Retarder and Locomotive Load Test Cell Absorptive Barriers

The type of noise barrier used as the basis for the cost estimates is composed of acoustical panels placed along both sides of the retarders and locomotive load cell test stands. The materials used in the construction of these barriers would typically consist of a heavy backing panel, faced with acoustical material, and then surfaced with a perforated or expended metal covering. The barriers would range from 8 to 12 feet (2.4 to 3.6 meters) high for retarders and cost between $108 and $162 per linear foot ($354 and $531 per meter) installed depending upon barrier height; barrier length is 150 feet (46 meters). The useful life of retarder barriers is estimated to be 10 years. For locomotive load cell test stands, the barriers would range from 20 (6.1) to 25 feet (7.6 meters) high and 150 feet (46 meters) in length. The cost per linear foot (meter) installed would range from $260 and $325 ($825 and $1,066) depending upon barrier height.

These cost estimates are based upon the construction of absorptive barriers similar to the prototype represented by those in existence in the BN yard at Northtown, Minnesota.

These barriers have been in use for almost five years and have been used for quantitative measurements of noise reduction.* The 8 ft x 8 ft (2.4 m x 2.4 m) panels in the Northtown installation were manufactured by Industrial Acoustics Co., Inc., who provided a price quote for June 1976 purchase.* The cost estimates for the higher barriers have been scaled from the data provided below. Constrained schedules did not permit a more detailed estimating procedure for the higher barriers.

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*Railroad Retarder Noise Reduction, Department of Transportation, DOT-TSC-NHTSA-79-35, May 1979, p. 58.

The BN installation requires vertical I beams between which the panels are slid. The beams are bolted to an extensive foundation which is a part of an oil spray system that is also used to reduce noise. To consider the barriers erected by themselves, alternate footings for the beams are hypothesized and costed. In the case of the DOT study,* configuration is a 5WF16 post (I beam) set six feet (1.8 meters) into the ground in a 14 in (36 cm) augered hole filled with concrete.

The configuration quoted was for both sides of a group retarder barrier, 143 ft (43.6 m) long with six doors in one side for access. The 8 ft x 8 ft (2.4 m x 2.4 m) panels are four inches thick with 16 ga. galvanized exteriors and 22 ga. interior perforated with 3/32" holes on 3/16" staggered centers. The inside of the panels is filled with mineral wool encapsulated in bags of polyethylene film for weather resistance.

The configuration of these barriers as well as the construction of the panels themselves is not necessarily optimized.

The initial cost estimates from the DOT report referenced earlier give a cost configuration as follows:

Panels and trim	$13,500
Supports	2,700
Installation	6,500
Total	$22,700

The total cost, when divided by the total length of twice 143 ft (43.6 m) or 286 ft (87 m) produces an average cost of $79.37 per linear foot ($260 per meter) of barrier. This number is close to the $75 per foot ($246 per meter) used in the previous background document.* The past estimate, however, is not adjusted for inflation beyond June 1976. Inflation of this value to the June 1979 value, requires application of an appropriate labor and materials index. The national average index of labor and materials produced by the Association of American Railroads is used for this purpose. The July 1, 1976 index is 235.5 and the July 1, 1979 index is 320.8. The second divided by the first produces a cost escalation factor of 1.36.

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*"Background Document for Proposed Revision to Rail Carrier Noise Emission Regulation," EPA 550/9-78-207, February 1979.

Applying the cost escalation factor to $79.37/foot ($260/m); the escalated value becomes $108/foot ($354/m).

The 1975 background document* estimated the life of the barriers at 10 years, and inspection of the five year old barriers at Northtown indicates that this is a reasonable number. Replacement of the barrier panels after 10 years of use will be somewhat less costly (in constant dollars) than building panels from scratch. We estimate that the job can be completed in two days using a crew of four men and a light hydraulic crane. The estimated cost configuration for renewal of the panels is as follows:

Labor (4 x 16 at $7.00/hr.)	$ 448
Crane (16 at $30.00/hr.)	480
Replacement Panels	13,500
Total	$14,428

Thus, provision of such barriers for an indefinite length of time requires an initial cost of $22,700 with an additional cost every ten years of $14,400.

Other Sources

The design and cost of highway barriers have been studied.** Interpolation of their cost from Figure 3-29 gives $62.50 per linear foot ($205/m) for steel barriers, eight feet high (1975 price, San Francisco). If escalated at 12 percent to 1976, the cost is $70 per linear foot ($230 per meter). This design is for double panel walls without acoustical packing.

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*"Background Document for Rairoad Noise Emission Standards," EPA 550/9-76-005, December 1975.

**Simpson, Miles A., Noise Barrier Design Handbook, February 1976, FHWA-RD-76-58.

Switch Engine Mufflers

At the present time, the only locomotive builder engaged in active development of a muffler system for switch engines is EMD. Although the system had been developed for a new model switch engine, it can be adapted to older switchers using the same basic naturally aspirated diesel engine. Car body modifications are necessary to accommodate the added equipment connected to the engine exhaust manifold. To raise the roof line of the older switchers, it will be necessary to fabricate and install a new hatch bonnet to replace the present roof hatch. In addition to the new hatch bonnet, the existing structure must be reinforced by the addition of bracing to support the new bonnet. The existing roof bracing must be removed to make room for the muffler and bonnet installation.

Depending on the type of diesel engine in the switcher, unit costs for the retrofit of the muffler in 1979 dollars is estimated to be:

Muffler and material costs, 12 cylinder, 645 series engine	$5,000
Muffler and material costs for 12 cylinder, 567 series engine	$5,000

The added cost of the 567 engine installation over the 645 series is due to the need to make provisions for the engine water line over the exhaust manifold.

Labor to install muffler	$ 500

Fabrication of the hatch bonnet is estimated to cost:

Material and labor	$ 800
New bracing and labor to install bonnet	$ 500

The total capital cost for each switch engine is $6,800-$7,300. More than 95 percent of the EMD switchers are of the older 567 series engine design.

Current ICC data shows than there are about 6,975 switcher in service. About 860 of these locomotives were built by manufacturers no longer active in locomotive development and they used diesel engines significantly different from the EMD 567 or 645 series. Because each of the series of these older engines represents a new design problem, it is estimated that the cost to retrofit mufflers because of lack of any economy of scale, it will be about $12,500 each, based on the current state of development by EMD.

Capital costs for switcher retrofit therefore are estimated to be:

.95 x 6115 x $7,300 = $42,407,525
.05 x 6115 x $6,800 = $21,079,100
860 x $12,500 = $10,750,000

The opportunity costs for the switcher retrofit are influenced by the scheduled overhaul cycle of these locomotives. It is assumed that, whenever possible, railroads will carry out the retrofit during a scheduled heavy overhaul and that the additional out-of-service time will be limited to that required to modify the hood structure and to install the hatch bonnet. Installation of the muffler on the engine should take no longer than the normal exhaust manifold rebuild and replacement. Normal switcher heavy overhaul varies between seven and nine years. With a compliance time for installation of mufflers of between four and six years, about 60 percent (4,533) of the switcher can be retrofitted during normal overhaul. For the remaining 2,442, a special modification program will be necessary. The full out-of-service time will be chargeable against the muffler retrofit. A total of 10 days can be anticipated as out-of-service time, attributable to movement of the switcher from its normal assigned location to the heavy overhaul shop and return at the 30 mph speed restriction on moving switcher on the main line railroad, plus the shop time to carry out the modification. In 1979, the daily value of a switcher is $800. Therefore, the opportunity costs for the 2,442 switchers is $19,536,000.

APPENDIX C

TABULATION OF RAILROAD COMPANIES STUDIED INCLUDING NUMBER OF YARDS OWNED AND COMPANY OWNERSHIP

Road Name	Number of Yards Owned	Ownership
Aberdeen & Rockfish	1	Independent
Akron & Barberton Belt	2	Baltimore & Ohio RR Company; Canton & Youngstown RR Co.; Conrail
Akron, Canton & Youngstown	3	Norfolk & Western Ry. Co.
Alameda Belt Line	1	Aff. with Western Pacific
Aliquippa & Southern	2	Jones & Laughlin Steel Corp.
Alton & Southern	1	St. Louis Southwestern & Missouri Pacific
Angelina & Neches River	2	Southland Paper Mills, Inc.
Ann Arbor	4	Detroit, Toledo & Ironton
Apache	1	Southern Forest Ind., Inc.
Apalachicola Northern	2	St. Joe Paper Company
Arcade & Attica	1	Independent
Arcata & Mad River	1	Simpson Timber Company
Arkansas & Louisiana Missouri	2	Olinkraft, Inc.
Aroostock Valley	1	Canadian Pacific, Ltd.
Ashley, Drew & Northern	1	Independent
Atchison, Topeka & Santa Fe	173	Santa Fe Ind., Inc.
Atlanta & St. Andrews Bay	5	International Paper
Atlanta & West Point	2	Seaboard Coast Line RR Co.
Baltimore & Ohio	181	Chesapeake & Ohio Ry. Co.
Baltimore & Ohio Chicago Terminal	9	Baltimore & Ohio RR Co.
Bangor & Aroostock	6	Amoskeag Co.
Bauxite & Northern	1	Aluminum Company of America
Belfast & Moosehead Lake	1	City of Belfast, Maine
Belt Ry. Company of Chicago	6	Various RR Companies
Bessemer & Lake Erie	6	U. S. Steel Corporation
Birmingham Southern	6	U. S. Steel Corporation
Boston & Maine	26	Bomaine
Brooklyn Eastern Dist. Terminal	1	Independent
Burlington Northern	297	Independent
Butte, Anaconda & Pacific	4	Anaconda Company

Road Name	Number of Yards Owned	Ownership
Cadiz	1	USRA and Stockholders
California Western	1	Georgia Pacific Corporation
Cambria & Indiana	2	Bethlehem Steel Corporation
Camino, Placerville & Lake Tahoe	2	Michigan-California Lumber Co.
Canadian National	3	Independent
Canton	1	Canton Company of Baltimore (sub. of Int'l. Mining Corp.)
Carolina & Northwestern (Norfolk Southern)	1	Southern Ry. Company
Carrollton	1	Louisville & Nashville; Seaboard Coast Line
Central California Traction	1	Southern Pacific; Atchison, Topeka & Santa Fe; Western Pacific
Central of Georgia	30	Southern Ry. Company
Central RR Company of New Jersey	13	Reading Company
Central Vermont	6	Grand Trunk Corporation
Chattahoochee Valley	2	West Point-Pepperill, Inc.
Chesapeake & Ohio	113	Chessie System, Inc.
Chesapeake Western	1	Norfolk & Western Ry. Co.
Chicago & Illinois Midland	6	Commonwealth Edison Company
Chicago & Illinois Western	1	DC Ind., Inc.
Chicago & Northwestern	154	Independent
Chicago, Milwaukee, St. Paul & Pacific	145	Chicago Milwaukee Corporation
Chicago River & Indiana	5	Penn Central Trans. Company
Chicago, Rock Island & Pacific	103	Independent
Chicago Short Line	1	Independent
Chicago South Shore & South Bend	1	Chesapeake & Ohio RR
Cincinnati, New Orleans & Texas Pac.	3	Southern Ry. Co.
City of Prineville	1	Independent
Clarendon & Pittsford	1	Vermont Marble Company
Cliffside	1	Cone Mills Corporation

Road Name	Number of Yards Owned	Ownership
Colorado & Southern	12	Burlington Northern, Inc.
Colorado & Wyoming	2	CR&L Steel Corporation
Conrail	1	USRA and Stockholders
Cuyahoga Valley	1	Jones & Laughlin Steel Corp.
Dansville & Mount Morris	1	Independent
Dardanelle & Russellville	1	McAlister Fuel Company
Davenport, Rock Island & Northwestern	1	Burlington Northern, Inc.; Chicago, Milwaukee, St. Paul & Pacific RR Company
Delaware & Hudson	23	Dereco-Norfolk & Western
Delta Valley & Southern	1	Independent
Denver & Rio Grande Western	30	Rio Grande Ind., Inc.
DeQueen & Eastern	2	Weyerhauser Company
Des Moines Union	1	Norfolk & Western Ry. Co.; Chicago, Milwaukee, St. Paul & Pacific RR Company
Detroit & Mackinac	4	Independent
Detroit & Toledo Shoreline	2	Grand Trunk Western RR Co.; Norfolk & Western Ry. Company
Detroit Terminal	2	Penn Central Trans. Company; Grand Trunk; Michigan Central RR
Detroit, Toledo & Ironton	13	Penn Central Trans. System
Duluth, Missabe & Iron Range	9	U. S. Steel Corporation
Duluth, Winnipeg & Pacific	1	Grand Trunk Corporation
Durham & Southern	3	Seaboard Coast Line RR Co.
El Dorado & Wesson	1	Independent
Elgin, Joliet & Eastern	13	U. S. Steel Corporation
Erie Lackawanna	91	Dereco-Norfolk & Western
Escanaba & Lake Superior	1	Independent

Road Name	Number of Yards Owned	Ownership
Fairport, Painesville & Eastern	2	Penn Central; Norfolk & Western Ry.
Florida East Coast	9	Independent
Fonda, Johnstown & Gloversville	1	Delaware Obego Corporation
Fordyce & Princeton	1	Georgia-Pacific Corporation
Fort Worth & Denver	10	Colorado & Southern; Burlington Northern, Inc., System
Fort Worth Belt	1	Missouri-Pacific RR Company
Gainesville Midland	1	Seaboard Coast Line RR Co.
Galveston, Houston & Henderson	5	Missouri-Kansas-Texas; Missouri-Pacific
Garden City Western	1	Garden City Company
Genessee & Wyoming	1	Independent
Georgia	7	Seaboard Coast Line
Grafton & Upton	1	Rockwell Int'l. Corporation
Grand Trunk Western	24	Grand Trunk Corporation (sub. of Canadian Nat'l. Ry. Co.)
Graysonia, Nashville & Ashdown	1	Independent
Great Western	1	Great Western Sugar Company (sub. of Great Western United Corporation)
Green Bay & Western	5	Independent
Greenwich & Johnsonville	1	Delaware & Hudson Ry. Company
Hartwell	1	Independent
High Point, Thomasville, & Denton	1	Winston-Salem Southbound Ry. Co.
Illinois Central Gulf	132	IC Ind., Inc.
Illinois Terminal	6	Independent
Indiana Harbor Belt	12	Conrail

Road Name	Number of Yards Owned	Ownership
Kansas City Terminal	1	Twelve RR Companies
Kentucky & Indiana Terminal	5	Independent
Lackawanna & Wyoming Valley	2	Erie Lackawanna Ry. Company
Lake Erie & Ft. Wayne	1	Norfolk & Western Ry. Company
Lake Erie, Franklin & Clarion	1	Independent
Lake Front Dock & RR Terminal	1	Penn Central; Baltimore & Ohio
Lake Superior & Ishpeming	5	Cleveland Cliffs Iron Company
Lake Superior Terminal & Transfer	1	B.N.; Chicago & Northwestern; Soo Line
Lake Terminal	2	U. S. Steel Corporation
Lancaster & Chester	1	H. W. Close, et al., Trustees
Laurinburg & Southern	1	Independent
Lehigh Valley	34	Penn Central
Long Island	4	Metro. Trans. Auth., New York
Los Angeles Junction	1	Atchison, Topeka & Santa Fe
Louisiana & Arkansas	8	Kansas City Southern Ry. Co.
Louisiana & Northwest	1	H. E. Salzberg Company
Louisiana & Pine Bluff	1	Olinkraft, Inc.
Louisville & Nashville	111	Seaboard Coast Line RR Company
Louisville & Wadley	1	Independent
Louisville, New Albany & Corydon	1	Independent
Maine Central	8	Independent
Magma Arizona	1	Magma Copper Company
Manufacturers Junction	1	Western Electric Co., Inc.
Massena Terminal	1	Aluminum Company of America
McCloud River	1	Champion International Corp.
Meridian & Bigbee	4	American Can Company
Minneapolis, Northfield & Southern	4	Independent
Minnesota, Dakota & Western	1	Boise Cascade Corporation

Road Name	Number of Yards Owned	Ownership
Minnesota Transfer	1	Burlington Northern; Chicago, Milwaukee, St. Paul & Pacific RR; Chicago & Northwestern Trans. Co.; Chicago, Rock Island & Pacific RR; Soo Line
Mississippian	1	Independent
Mississippi Export	2	Independent
Missouri-Illinois	4	Missouri Pacific RR Company
Missouri-Kansas-Texas	33	Katy Ind., Inc.
Missouri Pacific	135	Missouri Pacific Corporation
Mobile & Gulf	1	James Graham Brown Foundation, Inc.
Monongahela	6	Penn Central; Baltimore & Ohio; Pittsburgh & Lake Erie
Monongahela Connecting	1	Jones & Laughlin Steel Corp.
Montour	2	Pittsburgh & Lake Erie RR Co.
Morristown & Erie	1	Subsidiary of Whippany Dev. Co. & ME Associates
Moscow, Camden & San Augustine	1	Independent
Moshassuck Valley	1	Independent
Mount Hood	1	100% Subsidiary of Union Pacific
Nevada Northern	4	Kennecott Copper Company
Newburgh & South Shore	3	U. S. Steel Corporation
New Orleans & Lower Coast	2	Missouri Pacific RR Company
New York Dock	1	Subsidiary of NYD Properties, Inc.
New York, Susquehanna & Western	3	Tri-Terminal Corporation
Norfolk, Franklin & Danville	2	Norfolk & Western Ry. Company
Norfolk & Portsmouth Belt Line	3	Seaboard Coast Line (four other RRs)
Norfolk Southern	9	Southern Ry. Company
Norfolk & Western	180	Independent
North Louisiana & Gulf	2	Continental Group, Inc.
Northwestern Pacific	7	Southern Pacific Trans. Company

Road Name	Number of Yards Owned	Ownership
Oakland Terminal	1	Western Pacific; Atchison, Topeka & Santa Fe
Pecos Valley Southern	1	Independent
Penn Central Trans. Company	567	Penn Central Company
Pennsylvania, Reading Seashore Lines	14	Penn Central Company
Peoria & Pekin Union Ry. Co.	5	Independent
Pittsburgh & Lake Erie	16	Penn Central Company
Pittsburgh & Ohio Valley	1	Shenango, Inc.
Pittsburgh, Chartiers & Youghiogheny	3	Conrail; Pittsburgh & Lake Erie
Port Huron & Detroit	1	Independent
Portland Terminal	2	B.N.; Oregon & Washington RR & Nav. Co.; Southern Pacific
Prescott & Northwestern	1	Potlatch Corporation
Providence & Worcester	2	Independent
Quanah, Acme & Pacific	2	St. Louis-S.F. Ry. Company
Quincy	1	Sierra Pacific Ind.
Rahway Valley	1	Independent
Reading	47	Conrail
Richmond, Fredericksburg & Potomac	4	Richmond-Washington Company
River Terminal	5	St. Paul Iron Mining Company (subsidiary of Republic Steel Corporation)
Roscoe, Snyder & Pacific	1	Independent

Road Name	Number of Yards Owned	Ownership
Saint Joseph Terminal	1	Atchison, Topeka & Santa Fe St. Joseph Grand Island Ry. Co.
Saint Louis-San Francisco	76	Independent
Saint Louis Southwestern	22	Southern Pacific Trans. Company
Saint Marys	2	Gilman Paper Company
Salt Lake, Garfield & Western	1	Hagle Assoc.
San Diego & Arizona Eastern	1	Southern Pacific Trans. Co.
Sand Springs	1	Sand Springs Home
San Luis Central	1	Pea Vine Corporation
Santa Maria Valley	3	Estate of G. Allan Hancock
Seaboard Coast Line	180	Seaboard Coast Line Ind., Inc.
Sierra	1	Independent
Soo Line	44	Canadian Pacific, Ltd.
Southern	144	Independent
Southern Pacific	211	Southern Pacific Company
Southern San Luis Valley	1	Messrs. G. M. Oringdulph and H. Quiller
Spokane International	5	Union Pacific RR Company
Springfield Terminal (Vermont)	1	Boston & Main Corporation
Staten Island RR Corporation	2	Baltimore & Ohio RR Company
Stockton Terminal & Eastern	1	Stockton Terminal & Eastern RR Company
Terminal RR Assn. of St. Louis	8	Various RR Companies
Texas and Northern	1	Lone Star Steel Company
Texas City Terminal	2	Missouri-Kansas-Texas RR; Missouri-Pacific RR Company; Atchison, Topeka & Santa Fe
Texas Mexican	3	Manufacturers Hanover Trust Company
Texas-New Mexico	1	Missouri Pacific RR Company
Texas South-Eastern	1	Independent
Toledo, Angola & Western	1	Medusa Corporation

Road Name	Number of Yards Owned	Ownership
Toledo, Peoria & Western	7	Atchison, Topeka & Santa Fe; Penn Central
Toledo Terminal	3	Conrail; Chesapeake & Ohio; Baltimore & Ohio; Norfolk & Western
Trona	1	Kerr McGee Chemical Corporation
Tucson, Cornelia & Gila Bend	1	Independent
Union Pacific	136	Union Pacific Corporation
Union Terminal Railway (of Saint Joseph, Missouri)	1	Missouri Pacific RR Company
Upper Merion & Plymouth	2	Alan Wood Steel Company
Utah	3	UV Ind., Inc.
Ware Shoals	1	Riegel Textile Corporation
Warren & Ouachita Valley	1	Chicago, Rock Island & Pacific RR Company
Warren & Saline River	1	Potlatch Corporation
Western Maryland	22	Chesapeake & Ohio; Baltimore & Ohio
Western Pacific	21	Western Pacific Ind.
Western Railway of Alabama	1	Seaboard Coast Line System
White Sulphur Springs & Yellowstone Park	1	Montana Central RR & Rec. Co., Inc.; Rockland Oil Company
Winfield	1	Penn-Dixie Ind., Inc.
Winston-Salem Southbound	2	Norfolk & Western Ry.; Seaboard
Wyandotte Terminal	1	BASF Wyandotte Corporation
Youngstown & Southern	1	Montour RR Company
Yreka Western	1	Independent

APPENDIX D

TABULATION OF RAILROAD COMPANIES BY NAME AND CODE DESIGNATIONS (ACI AND UNIFORM ALPHA CODES)

This appendix lists the names of the railroad companies which appeared in the FRA/DOT data base. The data base was compiled by Standford Research Institute under contract with the FRA. The work is reported in #FRA/ORD-76/304 entitled, "Railroad Classification Yard Technology, A survey and Assessment," dated January 1977. Using this data base, railroad company ACI code numbers were extracted and then related to the uniform alpha code and railroad company names. The results are compiled and tabulated below. The listing shown makes use of another reference document entitled, "The Official Railroad Equipment Register", Volume 93, Number 2, NRPC, New York, N.Y., dated October 1977. This document was used to correlate the code numbers to individual railroad companies by name.

Two separate but similar tabulations are presented; the first listing of companies is based on ascending ACI code numbers, and the second listing of railroads is formatted on the basis of the lexicographic order of the alpha codes.

1	2	3
ASDA		ASBESTOS & DANVILLE
ASML		THE ATLANTA STONE MTN. & LITHONIA RWY. CO.
AUS		AUGUSTA & SUMMERVILLE RAILROAD CO.
AYSS		ALLEGHENY & SOUTH SIDE
BCE		BRITISH COLUMBIA HYDRO & POWER ATHORITY
BCRR		BOYNE CITY RAILROAD CO.
BMH		BEAUFORT & MOOREHEAD RR CO.
CCO		CLINCHFIELD RR CO.
CPA		CLOUDERSPORT & PORT ALLEGHANY
CPLJ		CAMP LEJEUNE RAILROAD CO.
CRP		CENTRAL RR OF PENNSYLVANIA
CSP		CAMAS PRAIRIE RR CO.
CZ		COAHULIA & ZACATECAS RW.
DLC		DRUMMOND LIGHTERAGE
DW		DETRCIT & WESTERN
DWML		DUE WEST MOTOR LINE
EM		EDGEMOOR & MANETTA RWY.
FCDN		FERRCCARRIL DE NACOZARI, SCT.
FERR		FELICIANA EASTERN RR CO.
FLT		FOSS LAUNCH & TUG
GFC		GRAND FALLS CENTRAL RWY. CO., LTD.
GTC		GULF TRANSPORT
HDM		HUDSON & MANHATTAN
HRDL		HUDSCN RIVER DAY LINE
HT		HOWARD TERMINAL
HUBA		HUDSCN BAY
IGN		INTERNATIONAL-GREAT NORTHERN
ISU		IOWA SOUTHERN UTILITIES (SOUTHERN IND. RR, INC.)
ITB		ISLAND TUG AD BARGEE
JE		JERSEYVILLE & EASTERN
JGS		JAMES GRIFFITHS & SONS
JSC		JOHNSTOWN & STONY CREEK RR CO.
KCC		KANSAS CITY CONNECTING RR CO.
KCMO		KANSAS CITY, MEXICO & ORIENT
KCWB		KANSAS CITY WESTPORT BELT
KNOR		KLAMATH NORTHERN RWY. CO.
LCCE		LEE COUNTY CENTRAL ELECTRIC
LE		LOUISIANA EASTERN RR
LPSG		LIVE OAK, PERRY & S. GEORGIA RWY. CO.
MAA		MAGMA ARIZONA RR CO.
MBRR		MERIDAN & BIGBEE RR CO.
MET		MODESTO & EMPIRE TRACTION CO.
MF		MIDDIE FORK
MG		THE MOBILE & GULF RR CO.
MID		MIDWAY
MLD		MIDLAND
MLST		MILSTEAD
MOT		MARINE OIL TRANSPORTATION
MOTC		MONTREAL TRAMWAYS
MVT		MT. VERNON TEMINAL
NODM		MEXICO NORTHWESTERN
NORM		NORMETAL
NOTM		NEW ORLEANS, TEXAS & MEXICO
NSC		NEWTEX S.S.
NSCT		NIAGARA, ST. CATHARINES & TORONTO

1. Uniform Alpha Code
2. ACI Code
3. Railroad Company Name

1	2	3
NYCN		NEW YORK CONNECTING RR
OMLP		OHIO MIDLAND LIGHT & POWER
PAUT		CONSCLIDATED RAIL CORP.
PBL		THE PHILADELPHIA BELT LINE RR CO.
PER		PORT EVERGLADES RWY.
PMKY		PITTSBURGH, MCKEESPORT & YOUCHOGHENY
PPBD		PORT OF PALM BEACH DISTRICT
PSFL		PUGET SOUND FREIGHT LINES
PST		PHILADELPHIA SUBURBAN TRANSPCRTATION
PSTB		PUGET SOUND TUG & BARGE
PT		PENINSULA TERMINAL CO.
PTRR		PORT TCWNSEND RR, INC.
PUCC		PORT UTILITIES
RC		ROSSIYN, CONNECTING RR CC.
SBM		ST. LOUIS, BROWNSVILLE & MEXICO
SFPP		SPRUCE FALL POWER & PAPER
SIRC		THE STATEN ISLAND RR CORP.
SLS		SEA-IAND SERVICE, INC.
SNBL		SIOUX CITY & NEW ORLEANS BARGE LINE
SNCO		SEAPCRT NAVIGATION
SSL		SKANEATELES SHORT LINE RR CORP.
ST		SPRINGFIELD TERMINAL RWY. CO. (VERMONT,
TAEA		TANGIPAHOA & EASTERN
TAS		TAMPA SOUTHERN RR
TEM		TEMISKAMING & NORTHERN ONTARIO
TTR		TIJUANA & TECATE RWY. CO.
UCR		UTAH COAL ROUTE
UO		UNION RR OF OREGON
VS		VALLEY AND SILETZ RR CO.
WAS		WAYNESBURG SOUTHERN
WATR		WATERVILIE
WAW		CONSCLIDATED RAIL CORP.
WBC		WLKES-BARRE CONNECTING RR
WIF		WEST INDIA FRUIT & STEAMSHIP
WLE		WHEELING & LAE ERIE
WT		WELDWOOD TRANSPORTATION LTD.
WTCO		WESTERN TRANSPORTATION CC.
WSR		WAHINGTON WESTERN
AS	001	ABILENE & SOUTHERN RALWAY CO.
ABB	002	THE AKRON & BARBERTON BELT RAILROAD COMPANY
ACY	003	THE AKRON, CANTON & YOUNGSTOWN RR CO.
AWW	004	ALGES, WINSLOW & WESTERN RAILWAY CO.
ARR	005	THE ALASKA RAILROAD
ACBL	007	AMERICAN COMMERCIAL BARGE LINES, INC.
AC	008	ALGOMA CENTRAL RAILWAY
AR	009	ABERDEEN & ROCKFISH RAILRCAD CO.
AA	010	ANN ARBOR
APA	011	THE APACHE RAILWAY COMPANY
AN	012	APALACHICLA NORTHERN RR CC.
ARA	013	ARCACE AND ATTICA RALROAD CORP.
ABL	014	ALAMEDA BELT LINE
ALM	016	ARKANSAS & LOUISIANA MISSCURI RWY. CC.
ABCK	017	ALASKA BRITISH COLUMBIA TRANSPORTATICN COMPANY
ALQS	018	ALIQUIPPA & SOUTHERN RAILROAD CO.
AMC	019	AMADCR CENTRAL RAILROAD CC.
AMR	020	THE ARCATA AND MAD RIVER RAIL ROAD CC.
ADN	021	ASHLEY, DREW & NORTHERN RAILWAY CO.

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ATSF	022	THE ATCHISON, TOPEKA & SANTA FE RWY. CO.
AWP	023	ATLANTA & WEST POINT RAILROAD CO.
ATW	025	ATLANTIC & WESTERN RAILWAY CO.
PRSL	027	CONSOLIDATED RAIL CORP.
AGS	029	THE ALABAMA GREAT SOUTHERN RAILROAD CO.
AEC	031	ATLANTIC & EAST CAROLINA RAILWAY CO.
ALS	032	THE ALTON & SOUTHERN RAILWAY CO.
AHW	033	THE AHNAPEE & WEST. RWY. CO. DIV. OF MCCLOUD RIV. RR CO.
ANR	035	ANGELINA & NECHES RIVER RR CO.
ARW	036	THE ARKANSAS WESTERN RAILWAY CO.
AVL	038	AROOSTOOK VALLEEY RALROAD CO.
AHT	039	ALASKA HYDRO-TRAIN
ASAB	042	ATLANTA & SAINT ANDREWS BAY RAILWAY CO.
APD	043	ALBANY PORT DISTRICT
AUG	044	AUGUSTA RAILROAD CO.
AL	046	ALMANOR RAILROAD CO.
ATCO	048	U.S. ENERGY RESEARCH & DEV. ADMINISTRATON
ARC	049	ALEXANDEER RALROAD COMPANY
BO	050	THE BALTIMORE & OHIO RR CO.
ART	051	AMERICAN REFRIGERATOR TRANSIT CO.
BE	052	CONSOLIDATED RAIL CORP.
BLA	053	THE BALTIMORE & ANNAPOLIS RR CO.
BFC	054	BELLEFONTE CENTRAL RR CO.
BVS	055	BEVIER & SOUTHERN RR CO.
BAR	056	BANGOR AND AROOSTOOK RAILROAD CO.
BCK	059	CONSOLIDATED RAIL CORPORATON
BEEM	060	BEECH MOUNTAIN RAILROAD CO.
BLE	061	BESSEMER & LAKE ERIE RR CO.
BLKM	063	BLACK MESA & LAKE POWELL
BOCT	064	THE BALTIMORE & OHIO CHICAGO TERM. RR CO.
BS	065	BIRMINGTON SOUTHERN RR CO.
BRW	066	BLACK RIVER & WESTERN CORP.
BM	069	BOSTON & MAINE CORP.
BME	073	BEAVER, MEADE & ENGLEWOOD
BMS	073	BERLIN MILLS
BN	076	BURLINGTON NORTHERN CO.
BAP	078	BUTTE, ANACONDA & PACIFIC RAILWAY CO.
BH	079	BATH & HAMMONDSPORT RR CO.
BRC	083	THE BELT RAILWAY CO. OF CHICAGO
BXN	084	BAUXITE & NORTHERN RAILWAY CO.
BML	087	BELFAST & MOOSEHEAD LAKE RR CO.
BRFD	088	BRANFORD STEAM RAILROAD
CSSL	090	CANADA STEAMSHIP LINES
BEDT	091	BROOKLYN EASTERN DISTRICT TERMINAL
CAD	092	CADIZ RR CO.
CLK	093	CADIILAC & LAKE CITY RWY. CO.
CWC	095	SEABOARD COAST LINE RR (CHARLESTON & WEST. CAROLINA)
CTN	097	CANTON RAILROAD CO.
CF	099	CAPE FEAR RAILWAYS, INC.
CWR	100	CALIFORNIA WESTERN RR
CI	101	CAMBRIA & INDIANA RR CO.
CN	103	CANADIAN NATIONAL RAILWAYS
CBC	104	CARBON COUNTY RWY. CO.
CP	105	CP RAIL (CANADIAN PACIFIC LTD.)
CRN	106	CAROIINA & NORTHWESTERN RWY. CO.
CKSO	107	CONDON, KINZUA & SOUTHERN RR CO.
CIC	111	CEDAR RAPIDS & IOWA CITY RAILWAY CO.

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CCT	112	CENTRAL CALIFORNIA TRACTION CO.
CARR	113	THE CARROLLTON RR.
CACV	114	COOPERSTOWN & CHARLOTTE VALLEY RR CORP.
CGT	115	THE CANADA & GULF TERMINAL RAILWAY CO.
CIND	116	CONSOLIDATED RAIL CORP.
CHR	117	CHESTNUT RIDGE RAILWAY CO.
CGA	118	CENTRAL OF GEORGIA RAILROAD CO.
CNJ	119	CONSOLIDATED RAIL CORP.
CV	120	CENTRAL VERMONT RWY. CO.
CHV	124	CHATTAHOOCHEE VALLEY RWY. CO.
CO	125	THE CHESAPEAKE & OHIO RWY. CO.
LM	127	LITCHFIELD & MADISON (CHIC. & N.W. TRANSP. CO.)
CEI	129	MISSOURI PACIFIC RR CO.
CIM	130	CHICAGO & ILLINOIS MIDLAND RWY. CO.
CNW	131	CHICAGO & NORTH WESTERN TRANSP. CO.
CWI	132	CHICAGO & WESTEN INDIANA RR CO.
CIL	137	LOUISVILLE & NASHVILLE RR CO. (CHIC, INDIAN. & LOUIS.)
CHTT	139	CHICAGO HEIGHTS TERMINAL TRANSFER RR CO.
MILW	140	CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC RR CO.
CPLT	141	CAMINO, PLACERVILLE & LAKE TAHOE RR CO.
CHH	142	CHESWICK & HARMAR
CRI	143	CONSOLIDATED RAIL CORP.
RI	145	CHICAGO, ROCK ISLAND & PACIFIC RR CO.
CSL	147	CHICAGO SHORT LINE RWY. CO.
CPTC	149	CHICAGO PRODUCE TERMINAL CO.
CIW	150	CHICAGO & ILLINOIS WESTERN RR
CNYK	151	CENTRAL NEW YORK RR CORP.
CNTP	153	THE CINCINNATI, NEW ORLEANS & TEXAS PACIFIC RWY. CO.
CS	157	THE COLORADO & SOUTHERN RWY. CO.
CW	158	THE COLORADO & WYOMING RWY. CO.
CNL	159	COLUMBIA, NEWBERRY & LAURENS RR CO.
CLC	163	COLUMBIA & COWLITZ RWY. CO.
COLI	164	COLONEL'S ISLAND
COP	166	CITY OF PRINEVILLE RWY.
CNOR	167	CINCINNATI NORTHERN
CSS	168	CHICAGO SOUTH SHORE & SOUTH BEND RR
CLP	169	THEE CLARENDON & PITTSFORD RR CO.
CWP	172	CHICAGO, WEST PULLMAN & SOUTHERN RR CO.
CAGY	177	COLUMBUS & GREENVILLE RWY. CO., INC.
CHW	179	CHESAPEAKE WESTERN RAILWAY
CMER	180	CURTIS, MILBURN & EASTERN RR CO.
CLIF	181	CLIFFSIDE RR CO.
CURB	184	CURTIS BAY RR CO.
CIRC	185	CENTRAL IOWA TRANSP. COOP. DBA CENT. IOWA RWY. CO.
CUVA	186	THE CUYAHOGA VALLEEY RWY. CO.
CLCO	188	CLAREMONT & CONCORD RWY. CO., INC.
CRE	189	CONSOLIDATED RAIL CORP. (EASTERN DISTRICT)
CR	190	CONSOLIDATED RAIL CORP.
DR	191	DARDANELLE & RUSSELLVILLE RR CO.
DRI	192	DAVENPORT, ROCK ISLAND & NORTHWESTERN RWY. CO.
DVS	193	DELTA VALLEY & SOUTHERN RWY. CO.
DH	195	DELAWARE & HUDSON RAILWAY CO.
DC	196	DELRAY CONNECTING RAILROAD COMPANY
DRGW	197	THE DENVER & RIO GRANDE WESTEN RR CO.
DQE	200	DE QUEEN & EASTERN RR CO.
CCR	201	THE CORINTH & COUNCE RR CO.
DMU	202	DES MOINES UNION RWY. CO.
DM	204	DETROIT & MACKINAC RWY. CO.

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DTS	205	THE DETROIT AND TOLEDO SHORE LINE RR CO.
BRR	207	BELTON RR CO.
DTI	208	DETROIT, TOLEDO & IRONTON RR CO.
DA	209	CP RAIL (CANADIAN PAC. LTD.) (DOM. ATL. RWY. CO.).
DKS	210	DONIPHAN, KENSETT & SEARCY RWY.
DNE	212	DULUTH & NORTHEASTERN RR CO.
DMIR	213	DULUTH, MISSABE & IRON RANGE RWY. CO.
CBL	215	CONEMAUGH & BLACK LICK RR CO.
DWP	216	DULUTH, WINNIPEG & PACIFIC RWY.
DS	217	DURHAM & SOUTHERN RWY. CO.
DT	219	DETROIT TERMINAL RR CO.
DMM	220	THE DANSVILLE AND MOUNT MORRIS RR CO.
CIRR	222	CHATTAHOOCHEE INDUSTRIAL RR
ETL	228	THE ESSEX TERMINAL RWY. CO.
EEC	229	EAST ERIE COMMERCIAL RR
EV	231	THE EVERETT RR CO.
ETWN	234	EAST TENNESSEE & WESTERN N.C. RR CO.
EJE	238	ELGIN, JOLIET & EASTERN RWY. CO. (CHIC. & OUTER BELT)
EL	240	CONSOLIDATED RAIL CORP.
ELS	241	ESCANABA & LAKE SUPERIOR RR CO.
EACH	242	EAST CAMDEN & HIGHLAND RR. CO.
EJR	245	EAST JERSEY RR AND TERMINAL CO.
EN	246	ESQUIMALT & NANAIMO RWY. CO.
EDW	247	EL DORADO & WESSON RWY. CO.
FPE	260	FAIRPORT, PAINSVILLE & EASTERN RWY. CO.
FEC	263	FLORIDA EAST COAST RWY. CO.
FJG	264	FONDA, JOHNSTOWN & GLOVERSVILLE RR CO.
FP	265	FORDYCE & PRINCETON RR CO.
FDDM	266	CHICAGO & NW TRANSP. CO. (FT. DODGE,DES MOINES & SOUTH RWY.)
FWD	268	FT. WORTH & DENVER RWY. CO.
FCIN	272	FRANKFORT & CINCINNATI RR CO.
FRDN	273	FERDINAND RR CO.
FWU	274	FT. WAYNE UNION
FCM	275	FERROCARRIL MEXICANO (MEXICAN)
FMS	276	FORT MYERS SOUTHERN RR CO.
FWB	277	FT. WORTH BELT RWY. CO.
FSVB	279	FT. SMITH & VAN BUREN RWY. CO.
SEE	281	FERROCARRILES UNIDOS DEL SURESTE, S.A. DE C.V.
FOR	282	FORE RIVER RR CORP.
SBC	283	FERROCARRIL SONORA BAJA CALIF., S.A. DE C.V.
MDP	285	MEXICANN PACIFIC RR CO.,INC. (FERROCARRIL MEX.DEL PACIFICO)
NDM	286	FERROCARRILES NACIONALES DE MEX(NATL.RWYS.OF MEX.)(CARS MKD.NDEM)
GCW	287	THE GARDEN CITY WESTERN RWY. CO.
GC	289	GRAHAM CTY. RR CO.
GM	290	GAINSVILLE MIDLAND RR CO.
NDT	291	FERROCARRIL NACIONAL DE TEHUANTEPEC(TEHUANTEPEC NAT'L.)
MGRS	292	FERROCARRILES NACIONALES DE MEXICO (NAT'L. RWYS OF MEXICO)
GHH	293	GALVESTON, HOUSTON & HENDESON RR CO.
GETY	294	GETTYSBURG RR CO.
GANO	298	THE GEORGIA NORTHERN RWY. CO.
GA	299	GEORGIA RR CO.
GSF	300	GEORGIA SOUTHERN & FLORIDA RWY. CO.
GRR	302	GEORGETOWN RR CO.
GWF	303	GALVESTON WHARVES
GSW	305	GREAT SOUTHWEST R.R., INC.
GRN	306	GREENVILLE & NORTHERN RWY. CO.
GNA	307	GRAYSONIA, NASHVILLE & ASHDOWN RR CO.

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GTW	308	GRAND TRUNK WESTERN RR CO.
GWR	311	THE GREAT WESTERN RWY. CO.
GBW	312	GREEN BAY & WESTERN RR CO.
GMRC	314	GREEN MTN. RR CORP.
GMO	317	ILLINOIS CENTRAL GULF RR CO. (GULF, MOBLE & OHIO RR CO.)
GWIN	319	GOODWIN RR INC.
GNWR	320	GENESEE & WYOMING RR CO.
GJ	321	GREENWICH & JOHNSONVILLE RWY. CO.
GRNR	322	THE GRAND RIVER RWY. CO.
GU	323	GRAFTON & UPTON RR CO.
HCRC	326	HILLSDALE CTY. RWY. CO., INC.
HE	328	HOLLIS & EASTERN RR CO.
HBS	329	HOBOKEN SHORE RR
HB	330	HAMPTON & BRANCHVILLE RR CO.
HSW	331	HELENA SOUTHWESTERN RR CO.
HN	332	THE HUTCHINSON & NORTHERN RWY. CO.
HRT	334	HARTWELL RWY. CO.
HMR	335	HOBOKEN MANUFACTURERS
HS	336	HARTFORD & SLOCOMB RR CO.
HLNE	338	HILLSBORO & NORTH EASTERN RWY. CO.
HI	339	HOLTON INTER-URBAN RWY. CO.
HBT	342	HOUSTON BELT & TERMINAL RWY. CO.
ICG	350	ILLINOIS CENTRAL GULF RR CO.
IC	351	ILLINOIS CENTRAL GULF RR CO. (ILLINOIS CENTRAL)
IU	353	INDIANAPOLIS UNION
ITC	354	ILLINOIS TERMINAL RR CO.
NCAN	356	INCAN SUPERIOR LTD.
IHB	357	INDIANA HARBOR BELT RR CO.
IBT	358	THE INTERATONAL BRIDGE & TERMINAL CO.
INT	361	INTESTATE RR CO.
DCI	362	DES MOINES & CENTRAL IOWA RAILWAY CO.
IRN	364	CONSOLIDATEED RAIL CORP.
HPTD	366	HIGH POINT, THOMASVILLE & DENTON RR CO.
SIRR	367	SOUTHERN INDUSTRIAL RR INC.
LAL	398	LIVONIA, AVON & LAKEVILLE RR CORP.
KCS	400	THE KANSAS CITY SOUTHERN RW. CO.
KCT	401	KANSAS CITY TERMINAL RWY. CO.
KIT	402	KEENTUCKY & INDIANA TERMINAL RR CO.
KENN	403	KENNECOTT COMPANY RR
LT	404	THE IAKE TERMINAL RR CO.
KT	405	KEENTUCKY & TENNESSEE RWY.
LEE	406	THE IAKE ERIE & EASTERN RR CO.
LDRT	407	THE IAKE FRONT DOCK & RR TERMINAL CO.
LASB	409	LACKAWAXEN & STOURBRIDGE RR CORP.
KC	410	THE KANAWHA CENTRAL RWY. CO.
KCNW	411	KELLEY'S CREEK & NORTHWESTERN RR CO.
KNC	412	KINGCOME NAVIGATION
LNE	413	CONSOLIDATED RAIL CORP.
KM	414	THE KANSAS & MISSOURI RWY. & TERMINAL CO.
LSTT	417	LAKE SUPERIOR TEMINAL & TRANSFER RWY. CO.
LWV	419	CONSOLIDATED RAIL CORP.
LEN	421	THE IAKE ERIE & NORTHERN RWY. CO.
LSBC	420	THE IA SALLE & BUREAU CTY. RR CO.
LTC	422	LAFFERTY TRANSPORTATION
LEF	423	LAKE ERIE, FRANKLIN & CLARION RR CO.
LEFW	424	LAKE ERIE & FT. WAYNE RR CO.

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LSI	425	LAKE SUPERIOR & ISHPEMING RR CO.
LC	426	LANCASTEER & CHESTER RWY. CO.
LRS	427	LAURINBURG & SOUTHERN RR CO.
LAJ	428	LOS ANGELES JUNCTION RWY. CO.
LHR	429	CONSOLIDATED RAIL CORP.
LON	430	LUDINGTON & NORTHERN RWY.
LV	431	CONSOLIDATED RAIL CORP.
LNO	434	LAONA & NORTHERN RWY. CO.
LRPA	435	LITTLE ROCK PORT RR
LI	436	THE LONG ISLAND RR CO.
LAWV	437	THE LORAIN & WEST VIRGINIA RWY. CO.
LDTC	439	LAWNDALE TRANSPORTATON CO.
LA	441	LOUISIANA & ARKANSAS RWY. CO.
LNW	442	THE LOUISIANA & NORTHWEST RR CO.
LPB	443	THE LOUISIANA & PINE BLUFF RWY. CO.
LN	444	LOUISVILLE & NASHVILLE RR CO.
LSO	445	LOUISIANA SOUTHERN RWY. CO.
LNAC	446	LOUISVILLE, NEW ALBANY & CORYDON RR CO.
LBR	447	THE LOWVILLE & BEAVER RIVER RR CO.
LCAM	448	LOUISIANA MIDLAND RWY. CO.
NC	449	LOUISVILLE & NASHVILLE RR CO. (NASHVLE, CHATANOOGA & ST. LOUIS)
LPN	450	LONGVIEW, PORTLAND & NORTHERN RWY. CO.
LW	451	LOUISVILLE & WADLEY RWY. CO.
MDRY	455	MADISON RWY. CO., INC.
MEC	456	MAINE CENTRAL RR CO.
BNML	457	BURLINGTON NORTHERN (MANITOBA) LIMITED
MJ	459	MANUFACTURERS' JUNCTION RWY. CO.
MRS	460	MANUFACTURERS RWY. CO.
MCER	461	MASSACHUSEETTS CENTRAL
MPA	463	MARYLAND & PENNSYLVANIA RR CO.
MWR	464	MUNCIE & WESTERN RR CO.
MD	465	MUNICIPAL DOCKS
MCR	466	MC CLOUD RIVER RR CO.
MTC	467	MYSTIC TERMINAL CO.
MBT	468	MARIANNA & BLOUNTSTOWN RR CO.
MAYW	469	MAYWOOD & SUGAR CREEK
CHP	470	FEERROCARRIL CHIHUAHUA AL PACIFICO, S.A.
MSTR	471	THE MASSENA TERMINAL RR CO.
MC	472	CONSOLIDATED RAIL CORP.
FCMA	473	FERROCARRIL DE MINATITAN AL CARMEN
MINE	474	MINNEAPOLIS EASTERN RWY. CO.
MNJ	475	MIDDLETOWN & NEW JERSEY RWY. CO., INC.
MIDH	479	MIDDLETOWN & HUMMELSTOWN RR CO.
MNS	480	MINNEAPOLIS, NORTHFIELD & SOUTHERN RWY.
SOO	482	SOO LINE RR CO.
MTFR	484	THE MINNESOTA TRANSFER RWY. CO.
MSLC	486	MINNESOTA SHORT LINES CO.
LMT	488	LOUISIANA MIDLAND TRANSPORT
MKT	490	MISSOURI-KANSAS-TEXAS RR CO.
MP	494	MISSOURI PACIFIC RR CO.
MGA	497	THE MONONGAHELA RWY. CO.
MCRR	498	THE MONONGAHELA CONNECTING RR CO.
MIGN	501	MICHIGAN NORTHERN RWY. CO., INC.
MTR	500	MONTOUR RR CO.
MISS	502	MISSISSIPPIAN
MSV	503	MISSISSIPPI & SKUNA VALLEY RR CO.
MSE	506	MISSISSIPPI EXPORT RR CO.

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MUV	507	MOSHASSUCK VALLEY RR CO.
FBL	508	FEDERAL BARGE LINES
MB	509	MONTPELIER & BARRE RR CO.
MDW	510	MINNESOTA, DAKOTA & WESTERN RWY. CO.
ME	511	MORRISTOWN & ERIE RR CO.
IAT	513	IOWA TEMINAL RR CO.
MI	515	MISSOURI-ILLINOIS RR CO.
MTW	520	MARINETTE, TOMAHAWK & WESTERN RR.
MIR	522	MINNEAPOLIS INDUSTRIAL RWY. CO.
METW	523	MUNICIPALITY OF EAST TROY, WISCONSIN
NAP	525	THE NARRAGANSETT PIER RR CO., INC.
NN	530	NEVADA NORTHERN RWY. CO.
NJII	533	N.J., INDIANA & ILLINOIS RR CO.
NLC	534	NEW ORLEANS & LOWER COAST RR CO.
NOPB	536	NEW ORLEANS PUBLIC BELT RR
NEZP	537	NEZPERCE RR CO.
NIAJ	538	CONSOLIDATED RAIL CORP.
NYLB	539	CONSOLIDATED RAIL CORP.
NYD	542	NEW YORK DOCK RWY.
NYSW	546	N.Y.,SUSQUEHANNA & WEST. RR CO. (WALTER G. SCOTT,TRUSTEE)
MCSA	548	MOSCOW, CAMDEN & SAN AUGUSTINE RR
NPB	549	NORFOLK & PORTSMOUTH BELT LINE RR CO.
NW	550	NORFOLK & WESTERN RWY. CO. (N & W DIST.)
NS	551	NORFOLK SOUTHERN RWY. CO.
MH	552	MOUNT HOOD RWY. CO.
NLG	553	NORTH LOUISIANA & GULF RR CO.
NB	554	NORTHAMPTON AND BATH RR CO.
NWP	559	NORTHWESTERN PACIFIC RR CO.
NJ	562	NAPIERVILLE JUNCTION RWY. CO.
NAR	563	NORTHERN ALBERTA RAILWAYS CO.
NBST	567	THE NEW BRAUNFELS & SERVTEX RR CO.
NSRC	570	NORTH STRATFORD RR CORP.
NSS	577	THE NEWBURGH & SOUTH SHORE RWY. CO.
SOR	578	SUN OIL CO. OF PENNA.
AD	580	NORFOLK, FRANKLIN & DANVILLE RAILWAY CO.
MHM	581	CONSOLIDATED RAIL CORP.
NFD	582	NORFOLK, FRANKLIN & DANVILLE RWY. CO.
MKC	583	MCKEESPORT CONNECTING RR CO.
MHCO	584	MARQUETTE & HURON MTN. RR CO., INC.
NHIR	585	NEW HOPE & IVYLAND RR CO.
OTR	586	TE OAKLAND TERMINAL RWY.
OCTR	587	OCTORARO RWY. INC.
NOKL	591	NORTHWESTERN OKLAHOMA RR CO.
ONRY	592	OGDENSBURG BRIDGE & PORT AUTHORITY
PFE	595	PACIFIC FRUIT EXPRESS CO.
ONW	596	OREGON & NORTHWESTERN RR CO.
OPE	597	OREGON, PACIFIC & EASTERN RWY. CO.
OLB	598	OMAHA, LINCOLN & BEATRICE RWY. CO.
OE	600	OREGON ELECTRIC RWY. CO.
OT	601	OREGON TRUNK RAILWAY
OCE	603	OREGON, CALIF., & EASTERN RWY. CO.
OR	604	OWASCO RIVER
PRT	606	PARR TERMINAL RR
PAM	607	PITTSBURGH, ALLEGHENY & MCKEES ROCKS RR CO.
PBR	609	PATAPSCO & BACK RIVERS RR CO.
PM	610	THE CHESAPEAKE & OHIO RWY. CO. (PERE MARQUETTE DIST.)
PI	614	PADUCAH & ILLINOIS RR

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PAR	615	CONSOLIDATED RAIL CORP.
POV	616	PITTSBURGH & OHIO VALLEY RWY. CO.
PTM	619	PORTLAND TERMINAL CO. (ME.)
PC	622	CONSOLIDATED RAIL CORP.
RDG	623	CONSOLIDATED RAIL CORP.
PICK	624	THE PICKENS RR CO.
PLE	626	THE PITTSBURGH & LAKE ERIE RR CO.
PS	627	THE PITTSBURGH & SHAWMUT RR CO.
PCY	629	PITTSBURGH, CHARTIERS & YOUGHIOGHENY RWY. CO.
PF	630	THE PIONEER & FAYETTE RAILROAD CO.
PW	631	PROVIDENCE & WORCESTER CO.
PRTD	632	PORTLAND TRACTION CO. (PORTLAND RR & TERMINAL DIV.)
PNW	634	THE PRESCOTT & NORTHWESTERN RR CO.
PRV	636	PEARL RIVER VALLEY RR CO.
PSR	639	PETALUMA & SANTA ROSA RR CO.
PNS	640	PHILADELPHIA & NORFOLK STEAMSHIP
PVS	644	THE PECOS VALLEY SOUTHERN RWY. CO.
PPU	645	PEORIA & PEKIN UNION RWY. CO.
PTC	646	PEORIA TERMINAL CO.
PHD	647	PORT HURON AD DETROIT RR CO.
PJR	648	PORT JERSEY
BFCF	650	BREMERTON FREIGHT CAR FERRY
PCN	651	POINT COMFORT & NORTHERN RWY. CO.
QAP	655	QUANAH, ACME & PACIFIC RW. CO.
QRR	656	QUINCY RR CO.
QC	658	QUEBEC CENTRAL RAILWAY CO.
PBNE	659	PHILA., BETHLEHEM & NEW ENGLAND RR CO.
RSB	662	ROCHESTER SUBWAY
RFP	663	RICHMOND, FREDERICKSBURG & POTOMAC RR CO.
RV	664	RAHWAY VALLEY R.R. RAHWAY VALLEY CO., LESSER
RT	665	THE RIVER TERMINAL RAILWAY CO.
RTM	666	THE RAILWAY TRANSFER CO. OF TE CITY OF MINNEAPOLIS
RS	669	THE ROBERVAL AND SAGUENAY RWY. CO.
RR	671	RARITAN RIVER RAIL ROAD CO.
RSP	673	ROSCOE, SNYDER & PACIFIC RWY. CO.
RSS	675	ROCKDALE, SANDOW & SOUTHERN RR CO.
RCR	676	ROCKTON & RON RWY.
PBVR	677	THE PORT BIENVILLE RR
SRN	678	SABINE RIVER & NORTHERN RR CO.
SSDK	679	SAVANNAH STATE DOCKS RR CO.
SJB	680	ST. JOSEPH BELL RWY. CO.
SC	681	SUMTER & CHOCTAW RWY. CO.
SM	682	ST.MARY'S RR CO.
SJT	683	ST. JOSEPH TERMINAL RR CO.
SJRT	685	ST. JOHNS RIVER TERMINAL
SRC	686	STRASBURG RR CO.
SCM	687	STROUDS CREEK & MUDDLETY RR
SLGW	690	SALT LAKE, GAFIELD & WESTERN RWY. CO.
SAN	691	SANDERSVILLE RR CO.
SLSF	693	ST. LOUIS-SAN FRANCISCO RWY. CO.
SSW	694	ST. LOUIS SOUTHWESTERN RWY. CO.
SLC	696	THE SAN LUIS CENTRAL RR CO.
SN	697	SACRAMENTO NORTHERN RWY.
SDAE	702	SAN DIEGO & ARIZONA EASTERN RWY. CO.
SSH	704	SOUTH SHORE
SLAW	705	ST. LAWRENCE RR, DIV. OF NAT'L. RWY. UTILIZATON CORP.
SSLV	706	SOUTHERN SAN LUIS VALLEY RR CO.
SS	707	SAND SPRINGS RWY. CO.
TSU	709	TULSA-SAPULPA UNION RWY. CO.

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3. Railroad Company Name

1	2	3
DVR	711	CAPE BRETON DEV. CORP. (COAL DIV.) DEVCO RWY.
SCL	712	SEABOARD COAST LINE RR CO.
STL	714	SEATRAIN LINES, INC.
SERA	716	SIERRA RAILROAD CO.
SBK	718	SOUTH BROOKLYN RWY. CO.
SIND	720	SOUTHERN INDIANA RWY., INC.
SP	721	SOUTHERN PACIFIC TRANSPORTATION CO.
SOU	724	SOUTHERN RWY. SYSTEM
SI	727	SPOKANE INTERNATIONAL RR CO.
STRT	729	THE STEWARTSTOWN RR CO.
SUN	734	SUNSET RAILWAY CO.
SCT	735	SIOUX CITY TERMINAL RWY.
SOPB	736	SOUTH PIERCE RR
FCP	738	FERROCARRIL DEL PACIFICO, S.A. DE C.V. (PAC FC DEL P)
STE	739	STOCKTON TERMINAL & EASTERN RR
SMV	741	SANTA MARIA VALLEY RR CO.
TEXC	750	TEXAS CENTRAL RR CO.
ONT	754	ONTARIO NORTHLAND RWY.
TAG	755	TENNESSEE, ALABAMA & GA. RWY. CO.
TRRA	757	TERMINAL RR ASSOC. OF ST. LOUIS
TASD	758	TERMINAL RWY., ALABAMA STATE DOCKS
TMBL	759	TACOMA MUNICIPAL BELT LINE RWY.
TP	760	MISSOURI PACIFIC RR CO.
TCT	761	TEXAS CITY TERMINAL RWY. CO.
TM	762	THE TEXAS MEXICAN RWY. CO.
TPMP	763	TEXAS PACIFIC-MISSOURI PACIFIC TERMINAL RR OF N. ORLEAS
TOE	764	TEXAS, OKLAHOMA & EASTERN RR CO.
TSE	765	TEXAS SOUTH-EASTERN RR CO.
TENN	767	TENNESSEE RAILWAY CO.
TPW	769	TOLEDO, PEORIA & WESTERN RR CO.
TT	771	THE TOLEDO TERMINAL RR CO.
THB	774	THE TORONTO, HAMILTON & BUFFALO RWY. CO.
TPT	778	CONSIIDATED RAIL CORP.
TRC	779	TRONA RWY. CO.
TOV	782	TOOELE VALLEY RWY. CO.
TCG	783	TUSCON, CORNELIA & GILA BEND RR CO.
TS	784	TIDEWATER SOUTHERN RWY. CO.
TAW	785	THE TOLEDO, ANGOLA & WESTERN RWY. CO.
TNM	788	TEXAS-NEW MEXICO RWY. CO.
SB	791	SOUTH BUFFALO RAILWAY CO.
SOT	792	SOUTH OMAHA TERMINAL RWY. CO.
SJL	793	ST. JOHNSBURY & LAMOILLE CTY. RR.
SMA	794	SAN MANUEL ARIZONA RR CO.
TN	795	TEXAS & NORTHERN RWY. CO.
TYC	796	TYLERDALE CONNECTING
WRWK	797	WARWICK RWY. CO.
TB	798	TWIN BRANCH RR CO.
SH	799	STEELTON & HIGHSPIRE RR CO.
UP	802	UNION PAC. RR CO.(OREGON SHORT LINE;OR.-WASH RR & NAVIGAT.)
URR	803	UNION RR CO. (PITTSBURGH, PA.)
URY	804	UNION RY. OF MEMPHIS
UNI	805	UNITY RWYS. CO.
UT	807	UNION TERMINAL RWY. (OF ST. JOSEPH, MO.)
UMP	808	UPPER MERION & PLYMOUTH RR CO.
UTR	809	UNION TRANSPORTATION
UTAH	811	UTAH RWY. CO.
VALE	814	THE VALLEY RR CO.

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3. Railroad Company Name

1	2	3
VAMD	815	VIRGINIA & MARYLAND RR
VSO	816	VALDOSTA SOUTHERN RR
VTR	817	VERMONT RWY. INC.
VBR	819	VIRGINIA BLUE RIDGE RWY.
VC	820	VIRGINIA CENTRAL RWY.
VCY	821	VENTURA CTY. RWY. CO.
VNOR	822	VERMONT NORTHERN RR CO.
VE	824	VISALIA ELECTRIC RR CO.
WWV	826	WALLA WALLA VALLEY RWY. CO.
WAR	827	WARRENTON RR CO.
WS	828	WARE SHOALS RR C.
WOV	829	WARREN & QUACHITA VALLEY RWY. CO.
WYS	830	WYANDOTTE SOUTHERN RR C.
WIM	831	WASHINGTON, IDAHO & MONTANA RWY. CO.
WSB	832	WARREN & SALINE RIVER RR CO.
WYT	833	WYANDOTTE TERMINAL RR CO.
WAL	834	WESTERN ALLEGHENY RR CO.
WLO	835	WATERLOO RR CO.
WMWN	837	THE WEATHERFORD, MINEAL WELLS & NORTHWESTEN RWY. CO.
WRRC	838	WESTERN RAIL ROAD CO.
WM	839	WESTERN MARYLAND RWY. CO.
WP	840	THE WESTERN PACIFIC RR CO.
WA	841	THE WESTERN RWY. OF ALABAMA
WHN	842	CONSOLIDATED RAIL CORP.
WCTR	844	WCTU RWY. CO.
WPY	845	WHITE PASS & YUKON ROUTE
WSYP	846	WHITE SULPHUR SPRINGS & YELLOWSTONE RWY. CO.
WMSC	847	WHITE MOUNTAIN SCENIC RR
WAG	848	WELLSVILLE, ADDISON & GALETON RR CORP.
WATC	849	THE WASHINGTON TERMINAL CO.
WW	850	WINCHESTER & WESTERN RR CO.
WNF	851	THE WINFIELD RR CO.
WNFR	852	WINFREDE RR CO.
WSS	854	WINSTON-SALEM SOUTHBOUND RWY. CO.
WTOH	865	WESTERN OHIO RR CO.
WVN	866	WEST VIRGINIA NORTHERN RR C.
WBTS	867	WACO, BEAUMONT, TRNITY & SABINE RWY CO.
WLFB	869	WOLFEBORO RR CO., INC.
YVT	872	YAKIMA VALLEY TRANSPORTATION CO.
YW	873	YREKA WESTERN RR CO.
YS	875	YOUNGSTOWN & SOUTHERN RWY. CO.
YAN	876	YANCEY RR C.
YN	877	THE YOUNGSTOWN & NORTHERN RR CO.
BTCO	950	BOSTON TERMINAL CO.
CUST	951	CHICAGO UNION STATION CO.
FSUD	952	FORT STREET UNION DEPOT CO.
JTCO	953	JACKSONVILLE TERMINAL CO.
LAPT	954	LOS ANGELES UNION PASSENGER TERMINAL
MTCO	955	MACON TERMINAL CO.
OURD	956	THE OGDEN UNION RWY. & DEPOT CO.
SPUD	957	ST. PAUL UNION DEPOT CO.
TUST	958	TEXARKANA UNION STATION TRUST
DUTC	959	DALLAS UNION TERMINAL
NOT	960	NEW ORLEANS TERMINAL
MUSC	961	MEMPHIS UNION STATION CO.
MWRC	962	MT. WASHINGTON RWY. CO.
NPT	964	PORTLAND TERMINAL RR CO. (ORE.)
BCOL	997	BRITISH COLA. RWY. CO.

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3. Railroad Company Name

1	2	3
AA	010	ANN ARBOR
ABB	002	THE AKRON & BARBERTON BELT RAILROAD COMPANY
ABCK	017	ALASKA BRITISH COLUMBIA TRANSPORTATION COMPANY
ABL	014	ALAMEDA BELT LINE
AC	008	ALGOMA CENTRAL RAILWAY
ACBL	007	AMERICAN COMMERCIAL BARGE LINES, INC.
ACY	003	THE AKRON, CANTON & YOUNGSTOWN RR CO.
AD	580	NORFOLK, FRANKLIN & DANVILLE RAILWAY CO.
ADN	021	ASHLEY, DREW & NORTHEEERN RAILWAY CO.
AEC	031	ATL. & EAST COAST RAILWAY CO.
AGS	029	THE ALABAMA GREAT SOUTHERN RAILROAD CO.
AHT	039	ALASKA HYDRO-TRAIN
AHW	033	THE AHNAPEE & WEST. RWY. CO. DIV. OF MCCLOUD RIV. RR CO.
AL	046	ALMANOR RAILROAD CO.
ALM	016	ARKANSAS & LOUISIANA MISSOURI RWY. CO.
ALQS	018	ALIQUIPPA & SOUTHERN RAILROAD CO.
ALS	032	THE ALTON & SOUTHERN RAILWAY CO.
AMC	019	AMADOR CENTRAL RAILROAD CO.
AMR	020	THE ARCATA AND MAD RIVER RAIL ROAD CO.
AN	012	APALACHICLA NORTHERN RR CO.
ANR	035	ANGELINA & NECHES RIVER RR CO.
APA	011	THE APACHE RAILWAY COMPANY
APD	043	ALBANY PORT DISTRICT
AR	009	ABERDEEN & ROCKFISH RAILROAD CO.
ARA	013	ARCADE AND ATTICA RALROAD CORP.
ARC	049	ALEXANDEER RALROAD COMPANY
ARR	005	THE ALASKA RAILROAD
ART	051	AMERICAN REFRIGERATOR TRANSIT CO.
ARW	036	THE ARKANSAS WESTERN RAILWAY CO.
AS	001	ABILENE & SOUTHERN RALWAY CO.
ASAB	042	ATLANTA & SANT ANDREWS BAY RAILWAY CO.
ASDA		ASBESTOS & DANVILLE
ASML		THE ATLANTA STONE MTN. & LITHONIA RWY. CO.
ATCO	048	U.S. ENERGY RESEARCH & DEV. ADMINISTRATON
ATSF	022	THE ATCHISON, TOPEKA & SANTA FE RWY. CO.
ATW	025	ATLANTIC & WESTERN RAILWAY CO.
AUG	044	AUGUSTA RAILROAD CO.
AUS		AUGUSTA & SUMMERVILLE RAILROAD CO.
AVL	038	AROOSTOOK VALLEEY RALROAD CO.
AWP	023	ATLANTA & WEST POINT RAILROAD CO.
AWW	004	ALGES, WINSLOW & WESTERN RAILWAY CO.
AYSS		ALLEGHENY & SOUTH SIDE
BAP	078	BUTTE, ANACONDA & PACIFIC RAILWAY CO.
BAR	056	BANGOR AND AROOSTOOK RAILROAD CO.
BCE		BRITISH COLUMBIA HYDRO & POWER ATHORITY
BCK	059	CONSOLIDATED RAIL CORPORATON
BCCL	997	BRITISH COLA. RWY. CO.
BCRR		BOYNE CITY RAILROAD CO.
BE	052	CONSOLIDATED RAIL CORP.
BEDT	091	BROOKLYN EASTERN DISTRICT TERMINAL
BEEM	060	BEECH MOUNTAIN RAILROAD CO.
BFC	054	BELLEFONTE CENTRAL RR CO.
BFCF	650	BREMERTON FREIGHT CAR FERRY
BH	079	BATH & HAMMONDSPORT RR CO.
BLA	053	THE BALTIMORE & ANNAPOLIS RR CO.
BLE	061	BESSEMER & LAKE ERIE RR CO.
BLKM	063	BLACK MESA & LAKE POWELL
BM	069	BOSTON & MAINE CORP.

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3. Railroad Company Name

1	2	3
BME	073	BEAVER, MEADE & ENGLEWOOD
BMH		BEAUFORT & MOOREHEAD RR CO.
BML	087	BELFAST & MOOSEHEAD LAKE RR CO.
BMS	073	BEERLIN MILLS
BN	076	BURLINGTON NORTHERN CO.
BNML	457	BURLINGTON NORTHERN (MANITOBA) LIMITED
BO	050	THEE BALTIMORE & OHIO RR CO.
BOCT	064	THE BALTIMORE & OHIO CHICAGO TERM. RR CO.
BRC	083	THE BELT RAILWAY CO. OF CHICAGO
BRFD	088	BRANFORD STEAM RAILROAD
BRR	207	BELTON RR CO.
BRW	066	BLACK RIVER & WESTERN CORP.
BS	065	BIRMINGTON SOUTHERN RR CO.
BTCO	950	BOSTON TERMINAL CO.
BVS	055	BEVIER & SOUTHERN RR CO.
BXN	084	BAUXITE & NORTHERN RAILWAY CO.
CACV	114	COOPERSTOWN & CHARLOTTE VALLEY RR CORP.
CAD	092	CADIZ RR CO.
CAGY	177	COLUMBUS & GREENVILLE RWY. CO., INC.
CARR	113	THE CARROLLTON RR.
CBC	104	CARBON COUNTY RWY. CO.
CBL	215	CONEMAUGH & BLACK LICK RR CO.
CCO		CLINCHFIELD RR CO.
CCR	201	THE CORINTH & COUNCE RR CO.
CCT	112	CENTRAL CALIFORNIA TRACTION CO.
CEI	129	MISSOURI PACIFIC RR CO.
CF	099	CAPE FEAR RAILWAYS, INC.
CGA		CENTRAL OF GEORGIA RAILROAD CO.
CGT	115	THE CANADA & GULF TERMINAL RAILWAY CO.
CHH	142	CHESWICK & HARMAR
CHP	470	FEERROCARRIL CHIHUAHUA AL PACIFICO, S.A.
CHR	117	CHESTNUT RIDGE RAILWAY CO.
CHTT	139	CHICAGO HEIGHTS TERMINAL TRANSFER RR CO.
CHV	124	CHATTAHOOCHEE VALLEY RWY. CO.
CHW	179	CHESAPEAKE WESTERN RAILWAY
CI	101	CAMBRIA & INDIANA RR CO.
CIC	111	CEDAR RAPIDS & IOWA CITY RAILWAY CO.
CIL	137	LOUISVILLE & NASHVILLE RR CO. (CHIC. INDIAN. & LOUIS.)
CIM	130	CHICAGO & ILLINOIS MIDLAND RWY. CO.
CIND	116	CONSOLIDATED RAIL CORP.
CIRC	185	CENTRAL IOWA TRANSP. COOP. DBA CENT. IOWA RWY. CO.
CIRR	222	CHATTAHOOCHEE INDUSTRIAL RR
CIW	150	CHICAGO & ILLINOIS WESTERN RR
CKSO	107	CONDON, KINZUA & SOUTHERN RR CO.
CLC	163	COLA. & COWITZ RWY. CO.
CLCO	188	CLAREMONT & CONCORD RWY. CO., INC.
CLIF	181	CLIFFSIDE RR CO.
CLK	093	CADILLAC & LAKE CITY RWY. CO.
CLP	169	THEE CLARENDON & PITTSFORD RR CO.
CMER	180	CURTIS, MILBURN & EASTERN RR CO.
CN	103	CANADIAN NATIONAL RAILWAYS
CNJ	119	CONSOLIDATED RAIL CORP.
CNL	159	COLUMBIA, NEWBERRY & LAURENS RR CO.
CNOR	167	CINCINNATI NORTHERN
CNTP	153	THE CINCINNATI, NEW ORLEANS & TEXAS PACIFIC RWY. CO.
CNW	131	CHICAGO & NORTH WESTERN TRANSP. CO.
CNYK	151	CENTRAL NEW YORK RR CORP.
CO	125	THE CHESAPEAKE & OHIO RWY. CO.

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3. Railroad Company Name

1	2	3
CCLI	164	COLONELS ISLAND
CCP	166	CITY OF PRINEVILLE RWY.
CP	105	CP RAIL (CANADIAN PACIFIC LTD.)
CPA		COUDERSPORT & PORT ALLEGHANY
CPLJ		CAMP LEJEUNE RAILROAD CO.
CPLT	141	CAMINO, PLACERVILLE & LAKE TAHOE RR CO.
CPTC	149	CHICAGO PRODUCE TERMINAL CO.
CR	190	CONSOLIDATED RAIL CORP.
CRE	189	CONSOLIDATED RAIL CORP. (EASTERN DISTRICT)
CRI	143	CONSOLIDATED RAIL CORP.
CRN	106	CAROLINA & NORTHWESTERN RWY. CO.
CRP		CENTRAL RR OF PENNSYLVANIA
CS	157	THE COLORADO & SOUTHERN RWY. CO.
CSL	147	CHICAGO SHORT LINE RWY. CO.
CSP		CAMAS PRAIRIE RR CO.
CSS	168	CHICAGO SOUTH SHORE & SOUTH BEND RR
CSSL	090	CANADA STEAMSHIP LINES
CTN	097	CANTON RAILROAD CO.
CURB	184	CURTIS BAY RR CO.
CUST	951	CHICAGO UNION STATION CO.
CUVA	186	THE CUYAHOGA VALLEEY RWY. CO.
CV	120	CENTRAL VEERMONT RWY. CO.
CW	158	THE COLORADO & WYOMING RWY. CO.
CWC	095	SEABOARD COAST LINE RR (CHARLESTON & WEST. CAROLINA)
CWI	132	CHICAGO & WESTEN INDIANA RR CO.
CWP	172	CHICAGO, WEST PULLMAN & SOUTHERN RR CO.
CWR	100	CALIFORNIA WESTERN RR
CZ		COAHUILA & ZACATECAS RW.
DA	209	CP RAIL (CANADIAN PAC. LTD.)(DOM. ATL. RWY. CO.)
DC	196	DELRAY CONNECTING RAILROAD COMPANY
DCI	362	DES MOINES & CENTRAL IOWA RAILWAY CO.
DH	195	DELAWARE & HUDSON RAILWAY CO.
DKS	210	DONIPHAN, KENSETT & SEARCY RWY.
DLC		DRUMMOND LIGHTERAGE
DM	204	DETROIT & MACKINAC RWY. CO.
DMIR	213	DULUTH, MISSABE & IRON RANGE RWY. CO.
DMM	220	THE DANSVILLE AND MOUNT MORRIS RR CO.
DMU	202	DES MOINES UNION RWY. CO.
DNE	212	DULUTH & NORTHEASTERN RR CO.
DQE	200	DE QUEEN & EASTERN RR CO.
DR	191	DARDANELLE & RUSSELLVILLE RR CO.
DRGW	197	THE DENVER & RIO GRANDE WESTEN RR CO.
DRI	192	DAVEENPORT, ROCK ISLAND & NORTWESTEEN RWY. CO.
DS	217	DURHAM & SOUTHERN RWY. CO.
DT	219	DETROIT TERMINAL RR CO.
DTI	208	DETROIT, TOLEDO & IRONTON RR CO.
DTS	205	THE DETROIT AND TOLEDO SHORE LINE RR CO.
DUTC	959	DALLAS UNION TERMINAL
DVR	711	CAPE BRETON DEV. CORP. (COAL DIV.) DEVCO RWY.
DVS	193	DELTA VALLEY & SOUTHERN RWY. CO.
DW		DETROIT & WESTERN
DWML		DUE WEST MOTOR LINE
DWP	216	DULUTH, WINNIPEG & PACIFIC RWY.
EACH	242	EAST CAMDEN & HIGHLAND RR. CO.
EDW	247	EL DORADO & WESSON RWY. CO.
EEC	229	EAST ERIE COMMERCIAL RR

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3. Railroad Company Name

1	2	3
EJE	238	ELGIN, JOLIET & EASTERN RWY. CO. (CHIC. & OUTER BELT)
EJR	245	EAST JERSEY RR AND TERMINAL CO.
EL	240	CONSOLIDATED RAIL CORP.
ELS	241	ESCANABA & LAKE SUPERIOR RR CO.
EM		EDGEMOOR & MANETTA RWY.
EN	246	ESQUIMALT & NANAIMO RWY. CO.
ETL	228	THE ESSEX TERMINAL RWY. CO.
ETWN	234	EAST TENNESSEE & WESTERN N.C. RR CO.
EV	231	THE EVERETT RR CO.
FBL	508	FEDERAL BARGE LINES
FCDN		FERROCARRIL DE NACOZARI, SCT.
FCIN	272	FRANKFORT & CINCINNATI RR CO.
FCM	275	FERROCARRIL MEXICANO (MEXICAN)
FCP	738	FERROCARRIL DEL PACIFICO, S.A. DE C.V. (PAC FC DEL P)
FDDM	266	CHIC. & NW TRANSP. CO. (FT. DODGE,DES MOINES & SOUTH RWY.)
FCMA	473	FERROCARRIL DE MINATITAN AL CARMEN
FEC	263	FLORIDA EAST COAST RWY. CO.
FERR		FELICIANA EASTERN RR CO.
FJG	264	FONDA, JOHNSTOWN & GLOVERSVILLE RR CO.
FLT		FOSS LAUNCH & TUG
FMS	276	FORT MYERS SOUTHERN RR CO.
FOR	282	FORE RIVER RR CORP.
FP	265	FORDYCE & PRINCETON RR CO.
FPE	260	FAIRPORT, PAINSVILLE & EASTERN RWY. CO.
FRDN	273	FERDINAND RR CO.
FSLD	952	FORT STREEET UNION DEPOT CO.
FSVB	279	FT. SMITH & VAN BUREN RWY. CO.
FWB	277	FT. WORTH BELT RWY. CO.
FWD	268	FT. WORTH & DENVER RWY. CO.
FWU	274	FT. WAYNE UNION
GA	299	GEORGIA RR CO.
GANO	298	THE GEORGIA NORTHERN RWY. CO.
GBW	312	GREEN BAY & WESTERN RR CO.
GC	289	GRAHAM CTY. RR CO.
GCW	287	THE GARDEN CITY WESTERN RWY. CO.
GETY	294	GETTYSBURG RR CO.
GFC		GRAND FALLS CENTRAL RWY. CO., LTD.
GHH	293	GALVESTON, HOUSTON & HENDERSON RR CO.
GJ	321	GREENWICH & JOHNSONVILLE RWY. CO.
GM	290	GAINSVILLE MIDLAND RR CO.
GMO	317	ILLINOIS CENTRAL GULF RR CO. (GULF, MOBLE & OHIO RR CO.)
GMRC	314	GREEN MTN. RR CORP.
GNA	307	GRAYSONIA, NASHVILLE & ASHDOWN RR CO.
GNWR	320	GENESEE & WYOMING RR CO.
GRN	306	GREENVILLE & NORTHERN RWY. CO.
GRNR	322	THE GRAND RIVER RWY. CO.
GRR	302	GEORGETOWN RR CO.
GSF	300	GEORGIA SOUTHERN & FLORIDA RWY. CO.
GSW	305	GREAT SOUTHWEST R.R., INC.
GTC		GULF TRANSPORT
GTW	308	GRAND TRUNK WESTERN RR CO.
GU	323	GRAFTON & UPTON RR CO.
GWF	303	GALVESTON WHARVES
GWIN	319	GOODWIN RR INC.
GWR	311	THE GREAT WESTERN RWY. CO.
HB	330	HAMPTON & BRANCHVILLE RR CO.
HBS	329	HOBOKEN SHORE RR

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3. Railroad Company Name

1	2	3
HBT	342	HOLSTON BELT & TERMINAL RWY. CO.
HCRC	326	HILLSDALE CTY. RWY. CO., INC.
HDM		HUDSON & MANHATTAN
HE	328	HOLLIS & EASTERN RR CO.
HI	339	HOLTON INTER-URBAN RWY. CO.
HLNE	338	HILLSBORO & NORTH EASTERN RWY. CO.
HMR	335	HOBOKEN MANUFACTURERS
HN	332	THE HUTCHINSON & NORTHERN RWY. CO.
HPTD	366	HIGH POINT, THOMASVILLE & DENTON RR CO.
HRDL		HUDSON RIVER DAY LINE
HRT	334	HARTWELL RWY. CO.
HS	336	HARTFORD & SLOCOMB RR CO.
HSW	331	HELENA SOUTHWESTERN RR CO.
HT		HOWARD TERMINAL
HUBA		HUDSON BAY
IAT	513	IOWA TEMINAL RR CO.
IBT	358	THE INTENATONAL BRIDGE & TERMINAL CO.
IC	351	ILLINOIS CENTRAL GULF RR CO. (ILLINOIS CENTRAL)
ICG	350	ILLINOIS CENTRAL GULF RR CO.
IGN		INTERNATIONAL-GREAT NORTHERN
IHB	357	INDIANA HARBOR BELT RR CO.
INT	361	INTESTATE RR CO.
IRN	364	CONSOLIDATEED RAIL CORP.
ISU		IOWA SOUTHERN UTILITIES (SOUTHERN INC. RR, INC.)
ITB		ISLAND TUG AD BARGEE
ITC	354	ILLINOIS TERMINAL RR CO.
IU	353	INDIANAPOLIS UNION
JE		JERSEYVILLE & EASTERN
JGS		JAMES GRIFFITHS & SONS
JSC		JOHNSTOWN & STONY CREEK RR CO.
JTCO	953	JACKSONVILLE TERMINAL CO.
KC	410	THE KANAWHA CENTRAL RWY. CO.
KCC		KANSAS CITY CONNECTING RR CO.
KCMO		KANSAS CITY, MEXICO & ORIENT
KCNW	411	KELLEY'S CREEK & NORTHWESTERN RR CO.
KCS	400	THE KANSAS CITY SOUTHERN RY. CO.
KCT	401	KANSAS CITY TERMINAL RWY. CO.
KCWB		KANSAS CITY WESTPORT BELT
KENN	403	KENNECOTT COMPANY RR
KIT	402	KEENTUCKY & INDIANA TERMINAL RR CO.
KM	414	THE KANSAS & MISSOURI RWY. & TERMINAL CO.
KNC	412	KINGCOME NAVIGATION
KNOR		KLAMATH NORTHERN RWY. CO.
KT	405	KEENTUCKY & TENNESSEE RWY.
LA	441	LOUISIANA & ARKANSAS RWY. CO.
LAJ	428	LOS ANGELES JUNCTION RWY. CO.
LAL	398	LIVONIA, AVON & LAKEVILLE RR CORP.
LAPT	954	LOS ANGELES UNION PASSENGER TERMINAL
LASB	409	LACKAWAXEN & STOURBRIDGE RR CORP.
LAWV	437	THE LORAIN & WEST VIRGINIA RWY. CO.
LBR	447	THE LOWVILLE & BEAVER RIVER RR CO.
LC	426	LANCASTEER & CHESTER RWY. CO.
LCCE		LEE COUNTY CENTRAL ELECTRIC
LDRT	407	THE LAKE FRONT DOCK & RR TERMINAL CO.
LDTC	439	LAWNDALE TRANSPORTATON CO.
LE		LOUISIANA EASTERN RR
LEE	406	THE LAKE ERIE & EASTERN RR CO.

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1	2	3
LEF	423	LAKE ERIE, FRANKLIN & CLARION RR CO.
LEFW	424	LAKE ERIE & FT. WAYNE RR CO.
LEN	42L	THE LAKE ERIE & NORTHERN RWY. CO.
LHR	429	CONSOLIDATED RAIL CORP.
LI	436	THE LONG ISLAND RR CO.
LM	127	LITCHFIELD & MADISON (CHIC. & N.W. TRANSP. CO.)
LMT	488	LOUISIANA MIDLAND TRANSPORT
LN	444	LOUISVILLE & NASHVILLE RR CO.
LNAC	446	LOUISVILLE, NEW ALBANY & CORYDON RR CO.
LNE	413	CONSOLIDATED RAIL CORP.
LNG	434	LAGNA & NORTHERN RWY. CO.
LNW	442	THE LOUISIANA & NORTHWEST RR CO.
LOAM	448	LOUISIANA MIDLAND RWY. CO.
LPB	443	THE LOUISIANA & PINE BLUFF RWY. CO.
LPN	450	LONGVIEW, PORTLAND & NORTHERN RWY. CO.
LPSG		LIVE OAK, PERRY & S. GEORGIA RWY. CO.
LRPA	435	LITTLE ROCK PORT RR
LRS	427	LAURINBURG & SOUTHERN RR CO.
LSBC	420	THE LA SALLE & BUREAU CTY. RR CO.
LSI	425	LAKE SUPERIOR & ISHPEMING RR CO.
LSO	445	LOUISIANA SOUTHERN RWY. CO.
LSTT	417	LAKE SUPERIOR TEMINAL & TRANSFER RWY. CO.
LT	404	THE LAKE TERMINAL RR CO.
LTC	422	LAFFERTY TRANSPORTATION
LUN	430	LUDINGTON & NORTHERN RWY.
LV	431	CONSOLIDATED RAIL CORP.
LW	451	LOUISVILLE & WADLEY RWY. CO.
LWV	419	CONSOLIDATED RAIL CORP.
MAA		MAGMA ARIZONA RR CO.
MAYW	469	MAYWOOD & SUGAR CREEK
MB	509	MONTPELIER & BARRE RR CO.
MERR		MERICAN & BIGBEE RR CO.
MBT	468	MARIANNA & BLOUNTSTOWN RR CO.
MC	472	CONSOLIDATED RAIL CORP.
MCER	461	MASSACHUSEETTS CENTRAL
MCR	466	MC CLOUD RIVER RR CO.
MCRR	498	THE MONONGAHELA CONNECTING RR CO.
MCSA	548	MOSCOW, CAMDEN & SAN AUGUSTINE RR
MD	465	MUNICIPAL DOCKS
MDP	285	MEXICANN PACIFIC RR CO.,INC. (FERROCARRIL MEX.DEL PACIFICO)
MDRY	455	MADISON RWY. CO., INC.
MDW	510	MINNESOTA, DAKOTA & WESTERN RWY. CO.
ME	511	MORRISTOWN & ERIE RR CO.
MEC	456	MAINE CENTRAL RR CO.
MET		MODESTO & EMPIRE TRACTION CO.
METW	523	MUNICIPALITY OF EAST TROY, WISCONSIN
MF		MIDDLE FORK
MG		THE MOBILE & GULF RR CO.
MGA	497	THE MONONGAHELA RWY. CO.
MGRS	292	FERROCARRILES NACIONALES DE MEXICO (NAT'L. RWYS OF MEXICO)
MH	552	MOUNT HOOD RWY. CO.
MHCO	584	MARQUETTE & HURON MTN. RR CO., INC.
MHM	581	CONSOLIDATED RAIL CORP.
MI	515	MISSOURI-ILLINOIS RR CO.
MID		MIDWAY
MIDH	479	MIDDLETOWN & HUMMELSTOWN RR CO.
MIGN	50L	MICHIGAN NORTHERN RWY. CO., INC.

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1	2	3
MILW	140	CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC RR CO.
MINE	474	MINNEAPOLIS EASTERN RWY. CO.
MIR	522	MINNEAPOLIS INDUSTRIAL RWY. CO.
MISS	502	MISSISSIPPIAN
MJ	459	MANUFACTURERS' JUNCTION RWY. CO.
MKC	583	MCKEESPORT CONNECTING RR CO.
MKT	490	MISSOURI-KANSAS-TEXAS RR CO.
MLD		MIDLAND
MLST		MILSTEAD
MNJ	475	MIDDLETOWN & NEW JERSEY RWY. CO., INC.
MNS	480	MINNEAPOLIS, NORTHFIELD & SOUTHERN RWY.
MOT		MARINE OIL TRANSPORTATION
MCTC		MONTREAL TRAMWAYS
MCV	507	MOSHASSUCK VALLEY RR CO.
MP	494	MISSOURI PACIFIC RR CO.
MPA	463	MARYLAND & PENNA. RR CO.
MRS	460	MANUFACTURERS RWY. CO.
MSE	506	MISSISSIPPI EXPORT RR CO.
MSLC	486	MINNESOTA SHORT LINES CO.
MSTR	471	THE MASSENA TERMINAL RR CO.
MSV	503	MISSISSIPPI & SKUNA VALLEY RR CO.
MTC	467	MYSTIC TERMINAL CO.
MTCO	955	MACON TERMINAL CO.
MTFR	484	THE MINNESOTA TRANSFER RWY. CO.
MTR	500	MONTOUR RR CO.
MTW	520	MARINETTE, TOMAHAWK & WESTERN RR
MUSC	961	MEMPHIS UNION STATION CO.
MVT		MT. VERNON TEMINAL
MWR	464	MUNCIE & WESTERN RR CO.
MWRC	962	MT. WASHINGTON RWY. CO.
NAP	525	THE NARRAGANSETT PIER RR CO., INC.
NAR	563	NORTHERN ALBERTA RAILWAYS CO.
NB	554	NORTHAMPTON AND BATH RR CO.
NBST	567	THE NEW BRAUNFELS & SERVTEX RR CO.
NC	449	LOUISVILLE & NASHVILLE RR CO. (NASHVLE, CHATANOOGA & ST. LOUIS)
NCAN	356	INCAN SUPERIOR LTD.
NCM	286	FERROCARRILES NACIONALES DE MEX(NATL.RWYS.OF MEX.)(CARS MKD.NDEM)
NCT	291	FERROCARRIL NACIONAL DE TEHUANTEPEC(TEHUANTEPEC NAT'L.)
NEZP	537	NEZPERCE RR CO.
NFD	582	NORFOLK, FRANKLIN & DANVILLE RWY. CO.
NHIR	585	NEW HOPE & IVYLAND RR CO.
NIAJ	538	CONSOLIDATED RAIL CORP.
NJ	562	NAPIERVILLE JUNCTION RWY. CO.
NJII	533	N.J., INDIANA & ILLINOIS RR CO.
NLC	534	NEW ORLEANS & LOWER COAST RR CO.
NLG	553	NORTH LOUISIANA & GULF RR CO.
NN	530	NEVADA NORTHERN RWY. CO.
NCDM		MEXICO NORTHWESTERN
NOKL	591	NORTHWESTERN OKLAHOMA RR CO.
NOPB	536	NEW ORLEANS PUBLIC BELT RR
NCRM		NORMETAL
NCT	960	NEW ORLEANS TERMINAL
NCTM		NEW ORLEANS, TEXAS & MEXICO
NPB	549	NORFOLK & PORTSMOUTH BELT LINE RR CO.
NPT	964	PORTLAND TERMINAL RR CO. (ORE.)
NS	551	NORFOLK SOUTHERN RWY. CO.
NSC		NEWTEX S.S.
NSCT		NIAGARA, ST. CATHARINES & TORONTO
NSRC	570	NORTH STRATFORD RR CORP.

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1	2	3
NSS	577	THE NEWBURGH & SOUTH SHORE RWY. CO.
NW	550	NORFOLK & WESTERN RWY. CO. (N & W DIST.)
NWP	559	NORTHWESTERN PACIFIC RR CO.
NYCN		NEW YORK CONNECTING RR
NYD	542	NEW YORK DOCK RWY.
NYLB	539	CONSOLIDATED RAIL CORP.
NYSW	546	N.Y.,SUSQUEHANNA & WEST. RR CO. (WALTER G. SCOTT,TRUSTEE)
OCE	603	OREGON, CALIF., & EASTERN RWY. CO.
OCTR	587	OCTORARO RWY. INC.
OE	600	OREGON ELECTRIC RWY. CO.
OLB	598	OMAHA, LINCOLN & BEATRICE RWY. CO.
OMLP		OHIO MIDLAND LIGHT & POWER
ONRY	592	OGDENSBURG BRIDGE & PORT AUTHORITY
ONT	754	ONTARIO NORTHLAND RWY.
ONW	596	OREGON & NORTHWESTERN RR CO.
OPE	597	OREGON, PACIFIC & EASTERN RWY. CO.
OR	604	OWASCO RIVER
OT	601	OREGON TRUNK RAILWAY
OTR	586	TE OAKLAND TERMINAL RWY.
OURD	956	THE OGDEN UNION RWY. & DEPOT CO.
PAE	615	CONSOLIDATED RAIL CORP.
PAM	607	PGH., ALLEGHENY & MCKEES ROCKS RR CO.
PAUT		CONSOLIDATED RAIL CORP.
PBL		THE PHILADELPHIA BELT LINE RR CO.
PBNE	659	PHILA., BETHLEHEM & NEW ENGLAND RR CO.
PBR	609	PATAPSCO & BACK RIVERS RR CO.
PBVR	677	THE FORT BIENVILLE RR
PC	622	CONSOLIDATED RAIL CORP.
PCN	651	POINT COMFORT & NORTHERN RWY. CO.
PCY	629	PGH., CHARTIERS & YOUGHIOGHENY RWY. CO.
PER		PORT EVERGLADES RWY.
PF	630	THE PIONEER & FAYETTE RAILROAD CO.
PFE	595	PACIFIC FRUIT EXPRESS CO.
PHD	647	PORT HURON AD DETROIT RR CO.
PI	614	PADUCAH & ILLINOIS RR
PICK	624	THE PICKENS RR CO.
PJR	648	PORT JERSEY
PLE	626	THE PITTSBURGH & LAKE ERIE RR CO.
PM	610	THE CHESAPEAKE & OHIO RWY. CO. (PERE MARQUETTE DIST.)
PMKY		PITTSBURGH, MCKEESPORT & YOUGHIOGHENY
PNS	640	PHILADELPHIA & NORFOLK STEAMSHIP
PNW	634	THE PRESCOTT & NORTHWESTERN RR CO.
POV	616	PITTSBURGH & OHIO VALLEY RWY. CO.
PPBD		PORT OF PALM BEACH DISTRICT
PPU	645	PEORIA & PEKIN UNION RWY. CO.
PRSL	027	CONSOLIDATED RAIL CORP.
PRT	606	PARR TERMINAL RR
PRTD	632	PORTLAND TRACTION CO. (PORTLAND RR & TERMINAL DIV.)
PRV	636	PEARL RIVER VALLEY RR CO.
PS	627	THE PGH. & SHAWMUT RR CO.
PSFL		PUGET SOUND FREIGHT LINES
PSR	639	PETALUMA & SANTA ROSA RR CO.
PST		PHILADELPHIA SUBURBAN TRANSPORTATION
PSTB		PUGET SOUND TUG & BARGE
PT		PENINSULA TERMINAL CO.
PTC	646	PEORIA TERMINAL CO.
PTM	619	PORTLAND TERMINAL CO. (ME.)
PTRR		PORT TOWNSEND RR, INC.
PUCC		PORT UTILITIES

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1	2	3
PVS	644	THE PECOS VALLEY SOUTHERN RWY. CO.
PW	631	PROVIDENCE & WORCESTER CO.
QAP	655	QUANAH, ACME & PACIFIC RW. CO.
QC	658	QUEBEC CENTRAL RAILWAY CO.
QRR	656	QUINCY RR CO.
RC		ROSSLYN, CONNECTING RR CO.
RDG	623	CONSOLIDATED RAIL CORP.
RFP	663	RICHMOND, FREDERICKSBURG & POTOMAC RR CO.
RI	145	CHICAGO, ROCK ISLAND & PACIFIC RR CO.
RCR	676	ROCKTON & RON RWY.
RR	671	RARITAN RIVER RAIL ROAD CO.
RS	669	THE ROBERVAL AND SAGUENAY RWY. CO.
RSB	662	ROCHESTER SUBWAY
RSP	673	ROSCOE, SNYDER & PACIFIC RWY. CO.
RSS	675	ROCKDALE, SANDOW & SOUTHERN RR CO.
RT	665	THE RIVER TERMINAL RAILWAY CO.
RTM	666	THE RAILWAY TRANSFER CO. OF TE CITY OF MINNEAPOLIS
RV	664	RAHWAY VALLEY R.R. RAHWAY VALLEY CO., LESSEE
SAN	691	SANDERSVILLE RR CO.
SB	791	SOUTH BUFFALO RAILWAY CO.
SBC	283	FERROCARRIL SONORA BAJA CALIF., S.A. DE C.V.
SBK	718	SOUTH BROOKLYN RWY. CO.
SBM		ST. LOUIS, BROWNSVILLE & MEXICO
SC	681	SUMTER & CHOCTAW RWY. CO.
SCL	712	SEABOARD COAST LINE RR CO.
SCM	687	STROUDS CREEK & MUDDLETY RR
SCT	735	SIOUX XITY TERMINAL RWY.
SDAE	702	SAN DIEGO & ARIZONA EASTERN RWY. CO.
SEE	281	FERROCARRILES UNIDOS DEL SURESTE, S.A. DE C.V.
SERA	716	SIERRA RAILROAD CO.
SFPP		SPRUCE FALL POWER & PAPER
SH	799	STEELTON & HIGHSPIRE RR CO.
SI	727	SPOKANE INTERNATIONAL RR CO.
SIND	720	SOUTHERN INDIANA RWY., INC.
SIRC		THE STATEN ISLAND RR CORP.
SIRR	367	SOUTHERN INDUSTRIAL RR INC.
SJB	680	ST. JOSEPH BELL RWY. CO.
SJL	793	ST. JOHNSBURY & LAMOILLE CTY. RR.
SJRT	685	ST. JOHNS RIVER TERMINAL
SJT	683	ST. JOSEPH TERMINAL RR CO.
SLAW	705	ST. LAWRENCE RR, DIV. OF NAT'L. RWY. UTILIZATON CORP.
SLC	696	THE SAN LUIS CENTRAL RR CO.
SLGW	690	SALT LAKE, GAFIELD & WESTERN RWY. CO.
SLS		SEA-LAND SERVICE, INC.
SLSF	693	ST. LOUIS-SAN FRANCISCO RWY. CO.
SM	682	ST.MARY'S RR CO.
SMA	794	SAN MANUEL ARIZONA RR CO.
SMV	741	SANTA MARIA VALLEY RR CO.
SN	697	SACRAMENTO NORTHERN RWY.
SNBL		SIOUX CITY & NEW ORLEANS BARGE LINE
SNCO		SEAPORT NAVIGATION
SOO	482	SOO LINE RR CO.
SOPR	736	SOUTH PIERCE RR
SOT	792	SOUTH OMAHA TERMINAL RWY. CO.
SOU	724	SOUTHERN RWY. SYSTEM
SP	721	SOUTHERN PACIFIC TRANSPORTATION CO.
SPUD	957	ST. PAUL UNION DEPOT CO.
SRC	686	STRASBURG RR CO.
SRN	678	SABINE RIVER & NORTHERN RR CO.

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SRN	678	SABINE RIVER & NORTHERN RR CO.
SS	707	SAND SPRINGS RWY. CO.
SSDK	679	SAVANNAH STATE DOCKS RR CO.
SSH	704	SOUTH SHORE
SSL		SKANEATELES SHORT LINE RR CORP.
SSLV	706	SOUTHERN SAN LUIS VALLEY RR CO.
SSW	694	ST. LOUIS SOUTHWESTERN RWY. CO.
ST		SPRINGFIELD TERMINAL RWY. CO. (VERMONT)
STE	739	STOCKTON TERMINAL & EASTERN RR
STL	714	SEATRAIN LINES, INC.
STRT	729	THE STEWARTSTOWN RR CO.
SUN	734	SUNSET RAILWAY CO.
SUR	578	SUN OIL CO. OF PENNA.
TAEA		TANGIPAHOA & EASTERN
TAG	755	TENNESSEE, ALABAMA & GA. RWY. CO.
TAS		TAMPA SOUTHERN RR
TASD	758	TERMINAL RWY., ALABAMA STATE DOCKS
TAW	785	THE TOLEDO, ANGOLA & WESTERN RWY. CO.
TB	798	TWIN BRANCH RR CO.
TCG	783	TUSCON, CORNELIA & GILA BEND RR CO.
TCT	761	TEXAS CITY TERMINAL RWY. CO.
TEM		TEMISKAMING & NORTHERN ONTARIO
TENN	767	TENNESSEE RAILWAY CO.
TEXC	750	TEXAS CENTRAL RR CO.
THB	774	THE TORONTO, HAMILTON & BUFFALO RWY. CO.
TM	762	THE TEXAS MEXICAN RWY. CO.
TMBL	759	TACOMA MUNICIPAL BELT LINE RWY.
TN	795	TEXAS & NORTHERN RWY. CO.
TNM	788	TEXAS-NEW MEXICO RWY. CO.
TOE	764	TEXAS, OKLAHOMA & EASTERN RR CO.
TOV	782	TOOELE VALLEY RWY. CO.
TP	760	MISSOURI PACIFIC RR CO.
TPMP	763	TEXAS PACIFIC-MISSOURI PACIFIC TERMINAL RR OF N. ORLEAS
TPT	778	CONSLIDATED RAIL CORP.
TPW	769	TOLEDO, PEORIA & WESTERN RR CO.
TRC	779	TRONA RWY. CO.
TRRA	757	TERMINAL RR ASSOC. OF ST. LOUIS
TS	784	TIDEWATER SOUTHERN RWY. CO.
TSE	765	TEXAS SOUTH-EASTERN RR CO.
TSU	709	TULSA-SAPULPA UNION RWY. CO.
TT	771	THE TOLEDO TERMINAL RR CO.
TTR		TIJUANA & TECATE RWY. CO.
TUST	958	TEXARKANA UNION STATION TRUST
TYC	796	TYLERDALE CONNECTING
UCR		UTAH COAL ROUTE
UMP	808	UPPER MERION & PLYMOUTH RR CO.
UNI	805	UNITY RWYS. CO.
UO		UNION RR OF OREGON
UP	802	UNION PAC. RR CO.(OREGON SHORT LINE;ORE.-WASH RR & NAVIGAT.)
URR	803	UNION RR CO. (PITTSBURGH, PA.)
URY	804	UNION RY. OF MEMPHIS
UT	807	UNION TERMINAL RWY. (OF ST. JOSEPH, MO.)
UTAH	811	UTAH RWY. CO.
UTR	809	UNION TRANSPORTATION
VALE	814	THE VALLEY RR CO.
VAMD	815	VIRGINIA & MARYLAND RR
VBR	819	VIRGINIA BLUE RIDGE RWY.
VC	820	VIRGINIA CENTRAL RWY.
VCY	821	VENTURA CTY. RWY. CO.

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1	2	3
VE	824	VISALIA ELECTRIC RR CO.
VNOR	822	VERMONT NORTHERN RR CO.
VS		VALLEY AND SILETZ RR CO.
VSO	816	VALDOSTA SOUTHERN RR
VTR	817	VERMONT RWY. INC.
WA	841	THE WESTERN RWY. OF ALABAMA
WAG	848	WELLSVILLE, ADDISON & GALETON RR CORP.
WAL	834	WESTERN ALLEGHENY RR CO.
WAR	827	WARRENTON RR CO.
WAS		WAYNESBURG SOUTHERN
WATC	849	THE WASHINGTON TERMINAL CO.
WATR		WATERVILLE
WAW		CONSOLIDATED RAIL CORP.
WBC		WLKES-BARRE CONNECTING RR
WBTS	867	WACO, BEAUMONT, TRNITY & SABINE RWY CO.
WCTR	844	WCTU RWY. CO.
WHN	842	CONSOLIDATED RAIL CORP.
WIF		WEST INDIA FRUIT & STEAMSHIP
WIM	831	WASHINGTON, IDAHO & MONTANA RWY. CO.
WLE		WHEELING & LAE ERIE
WLFB	869	WOLFEBORO RR CO., INC.
WLO	835	WATERLOO RR CO.
WM	839	WESTERN MARYLAND RWY. CO.
WMSC	847	WHITE MOUNTAIN SCENIC RR
WMWN	837	THE WEATHERFORD, MINEAL WELLS & NORTHWESTEN RWY. CO.
WNF	851	THE WINFIELD RR CO.
WNFR	852	WINFREDE RR CO.
WOV	829	WARREN & QUACHITA VALLEY RWY. CO.
WP	840	THE WESTERN PACIFIC RR CO.
WPY	845	WHITE PASS & YUKON ROUTE
WRRC	838	WESTERN RAIL ROAD CO.
WRWK	797	WARWICK RWY. CO.
WS	828	WARE SHOALS RR C.
WSB	832	WARREN & SALINE RIVER RR CO.
WSS	854	WINSTON-SALEM SOUTHBOUND RWY. CO.
WSYP	846	WHITE SULPHUR SPRINGS & YELLOWSTONE RWY. CO.
WT		WELDWOOD TRANSPORTATION LTD.
WTCO		WESTERN TRANSPORTATION CO.
WTOH	865	WESTERN OHIO RR CO.
WVN	866	WEST VIRGINIA NORTHERN RR C.
WW	850	WINCHESTER & WESTERN RR CO.
WWR		WAHINGTON WESTERN
WWV	826	WALLA WALLA VALLEY RWY. CO.
WYS	830	WYANDOTTE SOUTHEERN RR C.
WYT	833	WYANDOTTE TERMINAL RR CO.
YAN	876	YANCEY RR C.
YN	877	THE YOUNGSTOWN & NORTHERN RR CO.
YS	875	YOUNGSTOWN & SOUTHERN RWY. CO.
YVT	872	YAKIMA VALLEY TRANSPORTATION CO.
YW	873	YREKA WESTERN RR CO.

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APPENDIX E

ECONOMIC IMPACTS BY RAILROAD COMPANY

Impacts of the railyard noise abatement regulations were calculated for each of 49 Class I and II railroads and 14 switching and terminal companies. These impacts were summarized in Section 6. The tables in this appendix present impacts by railroad. The order of presentation follows the summary discussion in Section 6. One should exercise caution interpreting the figures in these tables; as explained in Section 6, the residential only and residential/commercial impacts were calculated assuming a proportional reduction in the costs associated with the technologies involved applied equally to all railroads. Consequently, individual impacts may be overstated for some railroads and understated for others.

Table E-1

Present Value Total Capital Costs
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ATSF	1550.34	1739.19
2. BO	2231.92	2538.39
3. BAR	21.8925	28.0374
4. BLE	100.714	102.857
5. BM	320.943	369.045
6. BN	3811.43	4304.67
7. CV	0.	0.
8. CO	1526.27	1744.76
9. CIM	2.73656	3.50467
10. CNW	1164.51	1240.38
11. MILW	2591.13	2774.46
12. RI	1164.61	1276.91
13. CCO	106.187	109.866
14. CS	106.643	110.451
15. CONRAIL	8485.97	10504.4
16. DH	116.221	122.717
17. DRGW	315.014	361.452
18. DTI	204.721	246.328
19. DTS	196.512	235.814
20. DMIR	111.66	116.376
21. DWP	0.	0.
22. EJE	431.691	484.753
23. FEC	106.643	110.451
24. FWD	103.451	106.362
25. GA	3.19265	4.08878
26. GTW	140.394	153.675
27. ICG	1764.99	1961.84
28. ITC	101.17	103.441
29. KCS	242.477	258.284
30. LI	303.611	346.849
31. LN	1054.52	1234.83
32. MEC	210.094	216.812
33. MKT	122.607	130.894
34. MP	1243.16	1413.9
35. NW	2420.66	2753.98
36. NWP	0.	0.
37. PLE	130.36	140.824
38. RFP	399.409	479.806
39. SLSF	535.698	628.224
40. SSW	428.955	481.248
41. SCL	1264.06	1414.54
42. SOO	221.953	231.999
43. SP	3624.85	4045.18
44. SOU	2156.95	2541.29
45. TM	0.	0.
46. TPW	100.714	102.857
47. UP	1295.17	1490.78
48. WM	297.226	338.671
49. WP	105.275	108.658

Table E-2

Total Annualized Capital Costs
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ATSF	234.745	271.637
2. BO	307.255	355.831
3. BAR	21.8925	28.0374
4. BLE	11.8619	12.1143
5. BM	58.6836	70.2139
6. BN	655.727	771.904
7. CV	0.	0.
8. CO	214.97	250.602
9. CIM	2.73656	3.50467
10. CNW	191.434	215.609
11. MILW	382.717	426.082
12. RI	195.833	225.532
13. CCO	17.335	19.1236
14. CS	17.7911	19.7077
15. CONRAIL	1748.75	2121.48
16. DM	27.3691	31.9741
17. DRGW	52.7544	62.6204
18. DTI	31.3145	38.2398
19. DTS	23.1048	27.7258
20. DMIR	22.8082	26.133
21. DWP	0.	0.
22. EJE	80.5796	95.1786
23. FEC	17.7911	19.7077
24. FWD	14.5985	15.6189
25. GA	3.19265	4.08878
26. GTW	51.5421	62.932
27. ICG	271.695	312.805
28. ITC	12.318	12.6984
29. KCS	64.7722	76.7986
30. LI	41.352	48.0176
31. LN	183.189	220.996
32. MEC	32.3896	35.3267
33. MKT	33.7544	40.1517
34. MP	278.679	335.921
35. NW	407.143	480.679
36. NWP	0.	0.
37. PLE	41.508	50.0816
38. RFP	52.595	63.6292
39. SLSF	100.032	121.304
40. SSW	77.843	91.674
41. SCL	210.724	245.816
42. SOO	44.248	50.5136
43. SP	638.258	747.106
44. SOU	329.731	396.272
45. TM	0.	0.
46. TPW	11.8619	12.1143
47. UP	246.137	295.458
48. WM	34.9667	39.8401
49. WP	16.4228	17.9554

Table E-3

Annualized Operating and Maintenance Costs
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ATSF	385.442	476.388
2. BO	392.012	479.684
3. BAR	103.989	133.178
4. BLE	7.0873	7.23809
5. BM	133.291	167.772
6. BN	1364.6	1707.27
7. CV	0.	0.
8. CO	293.825	361.639
9. CIM	12.9987	16.6472
10. CNW	369.804	455.963
11. MILW	593.428	721.783
12. RI	393.009	488.264
13. CCO	33.0846	40.5325
14. CS	35.2511	43.307
15. CONRAIL	4292.32	5427.2
16. DH	80.7464	101.572
17. DRGW	105.127	131.703
18. DTI	52.5444	66.1996
19. DTS	13.5484	16.258
20. DMIR	59.082	73.8268
21. DWP	0.	0.
22. EJE	188.04	236.05
23. FEC	35.2511	43.307
24. FWD	20.086	23.8853
25. GA	15.1651	19.4217
26. GTW	195.568	248.622
27. ICG	462.444	571.326
28. ITC	9.25374	10.0126
29. KCS	209.155	264.184
30. LI	50.9659	62.3396
31. LN	386.835	487.365
32. MEC	55.337	67.1922
33. MKT	111.077	140.416
34. MP	788.842	997.785
35. NW	817.223	1022.41
36. NWP	0.	0.
37. PLE	147.906	187.583
38. RFP	57.427	71.3595
39. SLSF	233.497	295.011
40. SSW	175.041	219.402
41. SCL	416.802	519.481
42. SOO	111.665	139.33
43. SP	1375.51	1719.75
44. SOU	552.656	692.423
45. TM	0.	0.
46. TPW	7.0873	7.23809
47. UP	587.325	740.45
48. WM	20.6357	23.4961
49. WP	28.7518	34.9834

Table E-4
Total Annualized Cost
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ATSF	620.187	748.025
2. BO	699.267	835.515
3. BAR	125.882	161.215
4. BLE	18.9492	19.3524
5. BM	191.974	237.985
6. BN	2020.32	2479.18
7. CV	0.	0.
8. CO	508.795	612.241
9. CIM	15.7352	20.1518
10. CNW	561.239	671.572
11. MILW	976.144	1147.86
12. RI	588.841	713.796
13. CCO	50.4196	59.6561
14. CS	53.0422	63.0147
15. CONRAIL	6041.07	7548.68
16. DH	108.115	133.546
17. DRGW	157.881	194.323
18. DTI	83.8588	104.439
19. DTS	36.6532	43.9838
20. DMIR	81.8901	99.9597
21. DWP	0.	0.
22. EJE	268.619	331.228
23. FEC	53.0422	63.0147
24. FWD	34.6844	39.5042
25. GA	18.3578	23.5105
26. GTW	247.11	311.554
27. ICG	734.139	884.131
28. ITC	21.5717	22.711
29. KCS	273.927	340.982
30. LI	92.3179	110.357
31. LN	570.024	708.36
32. MEC	87.7266	102.519
33. MKT	144.831	180.567
34. MP	1067.52	1333.71
35. NW	1224.37	1503.08
36. NWP	0.	0.
37. PLE	189.414	237.664
38. RFP	110.022	134.989
39. SLSF	333.529	416.315
40. SSW	252.884	311.076
41. SCL	627.526	765.297
42. SOO	155.913	189.844
43. SP	2013.76	2466.86
44. SOU	882.386	1098.69
45. TM	0.	0.
46. TPW	18.9492	19.3524
47. UP	833.461	1035.91
48. WM	55.6024	63.3361
49. WP	45.1746	52.9388

Table E-5

Average Annual Cost Increase per Ton-Mile

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ATSF	0.000937	0.00113
2. BO	0.002745	0.00328
3. BAR	0.023932	0.030649
4. BLE	0.000797	0.00814
5. BM	0.007706	0.009553
6. BN	0.001869	0.002293
7. CV	0.	0.
8. CO	0.002128	0.002561
9. CIM	0.005588	0.007156
10. CNW	0.00231	0.002764
11. MILW	0.005483	0.006447
12. RI	0.004027	0.004882
13. CCO	0.001544	0.001827
14. CS	0.001273	0.001513
15. CONRAIL	0.006501	0.008123
16. DH	0.003142	0.003682
17. DRGW	0.00154	0.001896
18. DTI	0.005636	0.007019
19. DTS	0.01854	0.022248
20. DMIR	0.003482	0.00425
21. DWP	0.	0.
22. EJE	0.030411	0.037499
23. FEC	0.002223	0.002641
24. FWD	0.000863	0.000983
25. GA	0.002463	0.003154
26. GTW	0.006607	0.008329
27. ICG	0.002235	0.002691
28. ITC	0.004123	0.004341
29. KCS	0.002884	0.00359
30. LI	0.216201	0.258448
31. LN	0.001502	0.001866
32. MEC	0.009538	0.011146
33. MKT	0.002489	0.003104
34. MP	0.002045	0.002555
35. NW	0.00325	0.00399
36. NWP	0.	0.
37. PLE	0.015324	0.019227
38. RFP	0.009883	0.012126
39. SLSF	0.002027	0.00253
40. SSW	0.002476	0.003046
41. SCL	0.00181	0.002208
42. SOO	0.001425	0.001735
43. SP	0.002955	0.00362
44. SOU	0.001721	0.002123
45. TM	0.	0.
46. TPW	0.002905	0.002967
47. UP	0.001228	0.001527
48. WM	0.002858	0.003255
49. WP	0.000882	0.001033

Table E-6

Net Decrease in Revenue Ton-Miles
(in million revenue ton-miles)

	Residential Receiving Property		Residential/Commercial Receiving Property	
	Low	High	Low	High
1. ATSF	14.1038	39.2014	17.011	47.2819
2. BO	5.77956	18.7977	6.90566	22.4603
3. BAR	0.055128	39.17	7.06014	50.1644
4. BLE	0.150289	0.351272	0.153486	0.358746
5. BM	2.09008	12.6546	2.59101	15.6876
6. BN	36.3591	96.6909	44.6169	118.651
7. CV	0.	0.	0.	0.
8. CO	4.18254	13.5128	5.03292	16.2601
9. CIM	0.062517	0.186484	0.080064	0.238827
10. CNW	9.66655	25.5014	11.5669	30.5147
11. MILW	16.81	42.4582	19.7672	49.9273
12. RI	6.51135	24.5397	7.89309	29.7472
13. CCO	0.398139	1.55842	0.471074	1.8439
14. CS	0.881717	2.29183	1.04749	2.72271
15. CONRAIL	56.6751	174.799	70.819	218.422
16. DH	2.01086	10.0335	2.48385	12.3935
17. DRGW	1.48938	4.81416	1.83316	5.92535
18. DTI	0.405821	2.03608	0.505417	2.53577
19. DTS	0.24588	0.653842	0.295056	0.784609
20. DMIR	0.935168	2.07922	1.14152	2.53802
21. DWP	0.	0.	0.	0.
22. EJE	0.451032	2.34434	0.556156	2.89075
23. FEC	1.11092	4.45014	1.31979	5.29868
24. FWD	0.865887	1.90283	0.986211	2.16724
25. GA	0.148263	0.620568	0.189878	0.794752
26. GTW	2.83922	7.82513	3.57966	9.86586
27. ICG	13.1356	37.8924	15.8193	45.6342
28. ITC	0.111938	0.354664	0.11785	0.373395
29. KCS	4.56602	13.4941	5.68375	16.7974
30. LI	0.057582	0.326411	0.068834	0.390193
31. LN	6.24415	22.9578	7.75951	29.5293
32. MEC	0.934335	5.34674	1.09188	6.2483
33. MKT	3.36711	10.5931	4.19793	13.2069
34. MP	20.7496	66.4837	25.9236	83.0614
35. NW	11.9581	37.5139	14.6803	46.0537
36. NWP	0.	0.	0.	0.
37. PLE	0.888017	2.43342	1.11422	3.05329
38. RFP	0.996445	8.38755	1.22256	10.2909
39. SLSF	5.91882	19.1594	7.38794	23.915
40. SSW	5.06918	18.0866	6.23566	22.2485
41. SCL	7.42822	41.9086	9.05906	51.1096
42. SOO	4.19344	11.8689	5.10605	14.4519
43. SP	35.8663	114.089	43.9362	139.758
44. SOU	11.3163	56.0002	13.9622	69.0934
45. TM	0.	0.	0.	0.
46. TPW	0.220485	0.501183	0.225176	0.511846
47. UP	14.8706	39.7555	18.4826	49.412
48. WM	0.506015	1.82061	0.576397	2.07384
49. WP	0.742736	2.43032	0.870391	2.84802

Table E-7

Net Decrease in Employment
(round to nearest unit for employment decrease)

	Residential Receiving Property		Residential/Commercial Receiving Property	
	Low	High	Low	High
1. ATSF	7.09388	19.7174	8.55612	23.7817
2. BO	3.65261	11.8799	4.3643	14.1946
3. BAR	0.000105	0.074468	0.013422	0.095369
4. BLE	0.084572	0.197671	0.086371	0.201876
5. BM	2.58921	15.6767	3.20977	19.4339
6. BN	15.6991	41.7491	19.2646	51.2311
7. CV	0.	0.	0.	0.
8. CO	3.36521	10.8722	4.04941	13.0827
9. CIM	0.074372	0.221847	0.095247	0.284115
10. CNW	5.3799	14.1928	6.43753	16.9829
11. MILW	10.2282	25.8341	12.0275	30.3787
12. RI	3.68743	13.8971	4.46993	16.8461
13. CCO	0.090738	0.355173	0.107361	0.420237
14. CS	0.13802	0.358752	0.163969	0.4262
15. CONRAIL	55.6908	171.763	69.589	214.628
16. DH	1.12685	5.62259	1.39191	6.94514
17. DRGW	0.512203	1.6556	0.630429	2.03774
18. DTI	0.391639	1.96492	0.487755	2.44715
19. DTS	0.322119	0.856576	0.386543	1.02789
20. DMIR	0.664746	1.47809	0.811487	1.80424
21. DWP	0.	0.	0.	0.
22. EJE	1.57373	8.17985	1.94053	10.0864
23. FEC	0.490701	1.97007	0.582958	2.34046
24. FWD	0.255775	0.562078	0.291318	0.640185
25. GA	0.055104	0.230642	0.070571	0.295379
26. GTW	3.42036	9.42681	4.31236	11.8852
27. ICG	6.83489	19.7167	8.23132	23.745
28. ITC	0.123449	0.391134	0.129969	0.411791
29. KCS	1.49366	4.41427	1.8593	5.49486
30. LI	8.81537	49.9707	10.5379	59.7351
31. LN	2.46621	9.06749	3.06472	11.268
32. MEC	1.29921	7.43475	1.51828	8.68838
33. MKT	1.4122	4.44246	1.76065	5.53912
34. MP	7.97487	25.2318	9.83848	31.5233
35. NW	6.02555	18.9028	7.39722	23.2059
36. NWP	0.	0.	0.	0.
37. PLE	1.52445	4.17742	1.91278	5.24155
38. RFP	0.933608	7.85862	1.14547	9.64193
39. SLSF	2.97415	9.62745	3.71238	12.0171
40. SSW	2.08445	7.43721	2.56411	9.14961
41. SCL	4.55682	25.7088	5.55726	31.353
42. SOO	1.79681	5.08559	2.18784	6.19236
43. SP	18.2345	58.0029	22.3372	71.0534
44. SOU	0.000221	0.001092	0.000272	0.001347
45. TM	0.	0.	0.	0.
46. TPW	0.178836	0.40651	0.182641	0.415159
47. UP	5.82579	15.5749	7.24085	19.358
48. WM	0.30428	1.09478	0.346602	1.24705
49. WP	0.388869	1.27242	0.455705	1.49112

Table E-8

Weighted Average Price Elasticity of Demand

	Low	High
1. ATSF	0.512419	1.42426
2. BO	0.257183	0.836474
3. BAR	0.437934	3.11165
4. BLE	0.281528	0.658019
5. BM	0.370734	2.28098
6. BN	0.318338	0.846564
7. CV	0.524895	2.09314
8. CO	0.218716	0.706617
9. CIM	0.12839	0.382981
10. CNW	0.413542	1.09097
11. MILW	0.382449	0.465978
12. RI	0.27658	1.04237
13. CCO	0.147069	0.575666
14. CS	0.250629	0.651455
15. CONRAIL	0.283926	0.875693
16. DH	0.44545	2.22264
17. DRGW	0.196311	0.634537
18. DTI	0.214323	1.0753
19. DTS	0.390214	1.03765
20. DMIR	0.383573	0.852824
21. DWP	0.561986	2.48045
22. EJE	0.142568	0.741033
23. FEC	0.58895	2.36452
24. FWD	0.380833	0.836897
25. GA	0.197221	0.825486
26. GTW	0.548007	1.51035
27. ICG	0.374821	1.08125
28. ITC	0.211255	0.669337
29. KCS	0.319409	0.943963
30. LI	0.255631	1.44907
31. LN	0.23159	0.851482
32. MEC	0.524537	3.00167
33. MKT	0.516706	1.62559
34. MP	0.431452	1.38401
35. NW	0.248609	0.779914
36. NWP	0.571384	2.84751
37. PLE	0.229462	0.62879
38. RFP	0.288822	2.43115
39. SLSF	0.405427	1.31238
40. SSW	0.439022	1.56641
41. SCL	0.300816	1.69715
42. SOO	0.603755	1.70884
43. SP	0.422414	1.34367
44. SOU	0.280287	1.38703
45. TM	0.432611	1.91183
46. TPW	0.372867	0.847562
47. UP	0.385431	1.03043
48. WM	0.283912	1.0215
49. WP	0.453668	1.48445

Table E-9

Average Revenue per Ton-Mile
(in ¢ per ton-mile)

1.	ATSF	2.253
2.	BO	3.111
3.	BAR	N/A
4.	BLE	3.549
5.	BM	3.460
6.	BN	1.768
7.	CV	4.521
8.	CO	2.660
9.	CIM	3.232
10.	CNW	2.401
11.	MILW	2.220
12.	RI	2.501
13.	CCO	1.862
14.	CS	1.507
15.	CONRAIL	3.026
16.	DH	2.395
17.	DRGW	2.080
18.	DTI	4.428
19.	DTS	5.817
20.	DMIR	3.358
21.	DWP	2.228
22.	EJE	8.490
23.	FEC	2.812
24.	FED	1.525
25.	GA	2.441
26.	GTW	4.769
27.	ICG	2.094
28.	ITC	4.071
29.	KCS	1.916
30.	LI	40.983
31.	LN	2.114
32.	MEC	4.924
33.	MKT	2.222
34.	MP	2.222
35.	NW	2.545
36.	NWP	4.351
37.	PLE	4.894
38.	RFP	3.189
39.	SLSF	2.284
40.	SSW	2.190
41.	SCL	2.541
42.	SOO	2.244
43.	SP	2.371
44.	SOU	2.185
45.	TM	4.926
46.	TPW	3.205
47.	UP	2.160
48.	WM	3.119
49.	WP	2.759

Table E-10

Present Value Total Capital Costs
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ALQS	8.66578	11.0981
2. ALS	206.09	248.081
3. BOCT	0.	0.
4. BRC	414.916	499.666
5. BSRR	0.	0.
6. CUVA	6.38531	8.17757
7. IHB	738.14	871.632
8. LT	7.2975	9.3458
9. MGA	47.8898	61.3318
10. PBR	NA	NA
11. PTRR	0.	0.
12. SB	NA	NA
13. TRRA	325.504	374.886
14. URR	253.067	308.244

Table E-11

Annualized Capital Cost
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ALQS	8.66578	11.0981
2. ALS	32.6828	39.9921
3. BOCT	0.	0.
4. BRC	68.1021	83.4889
5. BSRR	0.	0.
6. CUVA	6.38531	8.17757
7. IHB	129.066	156.623
8. LT	7.2975	9.3458
9. MGA	47.8898	61.3318
10. PBR	NA	NA
11. PTRR	0.	0.
12. SB	NA	NA
13. TRRA	63.2445	76.055
14. URR	79.6604	100.156

Table E-12

Annualized Operating and Maintenance Cost
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ALQS	41.1624	52.7161
2. ALS	59.0437	74.5232
3. BOCT	0.	0.
4. BRC	131.086	165.694
5. BSRR	0.	0.
6. CUVA	30.3302	38.8434
7. IHB	275.209	347.338
8. LT	34.6631	44.3925
9. MGA	227.477	291.326
10. PBR	NA	NA
11. PTRR	0.	0.
12. SB	NA	NA
13. TRRA	154.955	195.517
14. URR	282.187	360.3

Table E-13

Total Annualized Cost
($ in 000)

	Residential Receiving Property	Residential/Commercial Receiving Property
1. ALQS	49.8282	63.8142
2. ALS	91.7265	114.515
3. BOCT	0.	0.
4. BRC	199.188	249.183
5. BSRR	0.	0.
6. CUVA	36.7156	47.021
7. IHB	404.275	503.961
8. LT	41.9606	53.7383
9. MGA	275.366	352.658
10. PBR	NA	NA
11. PTRR	0.	0.
12. SB	NA	NA
13. TRRA	218.2	271.572
14. URR	361.848	460.456

APPENDIX F

INDUSTRY PROFILE DATA

Table F-1
LOCOMOTIVE AND FREIGHT CAR INVENTORY
CLASS I LINE-HAUL RAILROADS (1976)

ROAD	NUMBER OF LOCOMOTIVE UNITS			FREIGHT CARS ON LINE
	YARD SERVICE	ROAD FREIGHT SERVICE	ROAD PASSENGER SERVICE	
EASTERN DISTRICT				
BALTIMORE & OHIO	143	800	0	73,896
BANGOR & AROOSTOOK	3	32	0	3,850
BESSEMER & LAKE ERIE	1	62	0	3,821
BOSTON & MAINE	61	104	0	6,870
CANADIAN PACIFIC - IN MAINE	1	20	3	21
CENTRAL VERMONT	2	14	0	505
CHESAPEAKE & OHIO	90	874	0	70,811
CHICAGO & ILLINOIS MIDLAND	8	13	0	765
CONRAIL	1,856	2,898	165	218,179
DELAWARE & HUDSON	39	125	0	7,827
DETROIT & TOLEDO SHORE LINE	6	10	0	1,008
DETROIT, TOLEDO & IRONTON	21	50	0	5,642
ELGIN, JOLIET & EASTERN	58	45	0	12,490
GRAND TRUNK WESTERN	91	92	3	15,527
ILLINOIS TERMINAL	20	15	0	1,935
LONG ISLAND	26	23	40	1,235
MAINE CENTRAL	17	50	0	3,492
NORFOLK & WESTERN	319	1,190	2	103,917
PITTSBURGH & LAKE ERIE	78	22	2	16,670
RICHMOND, FREDERICKSBURG & POT.	15	26	0	1,290
WESTERN MARYLAND	1	116	0	8,460
TOTAL EASTERN DISTRICT	2,856	6,581	215	558,211
SOUTHERN DISTRICT				
CLINCHFIELD	12	91	1	4,310
FLORIDA EAST COAST	10	47	0	2,952
GEORGIA	7	26	0	2,769
ILLINOIS CENTRAL GULF	165	884	25	62,752
LOUISVILLE & NASHVILLE	154	838	0	74,017
SEABOARD COAST LINE	213	1,087	0	76,957
SOUTHERN RY. SYSTEM	193	1,115	17	79,056
TOTAL SOUTHERN DISTRICT	754	4,088	43	302,813
WESTERN DISTRICT				
ATCHISON, TOPEKA & SANTA FE	163	1,552	0	76,909
BURLINGTON NORTHERN	516	1,644	21	119,250
CHICAGO & NORTH WESTERN	168	707	58	48,223
CHICAGO, MILW., ST. PAUL & PAC.	217	535	22	40,295
CHICAGO, ROCK ISLAND & PACIFIC	151	433	27	33,530
COLORADO & SOUTHERN	13	92	0	2,969
DENVER & RIO GRANDE WESTERN	32	197	6	9,117
DULUTH, MISSABE & IRON RANGE	36	35	0	8,572
DULUTH, WINNIPEG & PACIFIC	3	36	0	780
FORT WORTH & DENVER	6	14	0	2,178
KANSAS CITY SOUTHERN	77	136	0	6,454
MISSOURI-KANSAS-TEXAS	47	119	0	10,213
MISSOURI PACIFIC	260	822	0	66,305
NORTHWESTERN PACIFIC	0	50	0	1,120
ST. LOUIS-SAN FRANCISCO	92	358	0	22,597
ST. LOUIS SOUTHWESTERN	71	190	0	10,034
SOO LINE	55	172	0	14,802
SOUTHERN PACIFIC CO.	544	1,599	24	87,029
TEXAS MEXICAN	6	7	0	558
TOLEDO, PEORIA & WESTERN	4	27	0	889
UNION PACIFIC	247	1,171	0	67,944
WESTERN PACIFIC	12	134	0	5,372
TOTAL WESTERN DISTRICT	2,720	10,030	158	635,140
TOTAL UNITED STATES	6,330	20,699	416	1,496,164

Table F-3

TABULATION OF RAILROAD COMPANIES, INCLUDING ICC CLASS DESIGNATION, REGION AND DISTRIBUTION OF YARDS BY TYPE

Legend:

IRR ≡ ACI Code

ARR ≡ Uniform Alpha Code

C ≡ 1 if Class I
0 if Class II (1976/77)

R ≡ Region for Class I: 1 if Eastern
2 if Southern
3 if Western

NHM ≡ Number of Hump Yards

NFC ≡ Number of Flat Classification Yards

NFI ≡ Number of Flat Industrial Yards

NFS ≡ Number of Flat Small Industrial Yards

ITOTAL ≡ Total Number of Yards

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
2	ABB	0	0	0	0	2	0	2
3	ACY	0	0	0	2	1	0	3
4	AWW	0	0	0	0	2	0	2
9	AR	0	0	0	0	0	1	1
10	AA	0	0	0	2	2	0	4
11	APA	0	0	0	0	1	0	1
12	AN	0	0	0	0	1	1	2
13	ARA	0	0	0	0	1	0	1
14	ABL	0	0	0	0	1	0	1
16	ALM	0	0	0	0	1	1	2
18	ALQS	0	0	0	0	1	1	2
19	AMC	0	0	0	0	0	1	1
20	AMR	0	0	0	0	0	1	1
21	ADN	0	0	0	0	1	0	1

Table F-2

CLASS I SWITCHING AND TERMINAL COMPANIES

Uniform Alpha Code	(1977)
ALQS	Aliquippa and Southern RR Co.
ALS	Alton & Southern RR Co.
BOCT	Baltimore & Ohio Chicago Terminal RR Co.
BRC	Belt RR Co. of Chicago
BS	Birmingham Southern RR Co.
CBL	Conemaugh & Black Lick RR Co.
CUVA	Cuyahoga Valley RR Co.
HBT	Houston Belt & Terminal RR Co.
IHB	Indiana Harbor Belt RR Co.
IU	Indianapolis Union
KCT	Kansas City Terminal RR Co.
KIT	Kentucky & Indiana Terminal RR Co.
LT	Lake Terminal RR Co.
MCRR	Monongahela Connecting RR Co.
PBR	Patapsco & Black Rivers RR Co.
PBNE	Philadelphia, Bethlehem & New England RR Co.
PTM	Portland Terminal Co.
SB	South Buffalo RR Co.
TRRA	Terminal RR Assoc. of St. Louis
TPMP	Texas Pacific - Missouri Pacific Terminal RR Co. of New Orleans
URR	Union RR Co.
Uniform Alpha Code	(1978)
URR	Union RR Co.

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	TOTAL
22	ATSF	1	3	4	54	37	78	173
23	AWP	0	0	0	0	1	1	2
27	PRSL	1	0	0	0	4	10	14
31	AEC	0	0	0	0	0	2	2
32	ALS	0	0	1	0	0	0	2
35	ANR	0	0	0	0	1	1	2
38	AVL	0	0	0	0	0	1	1
42	ASAB	0	0	0	1	3	1	5
49	ARC	0	0	0	0	0	2	2
50	BO	1	1	7	60	51	63	181
56	BAR	1	1	0	3	2	1	6
59	BCK	1	0	0	0	1	0	1
61	BLE	1	1	0	4	2	0	6
64	BOCT	0	0	0	3	4	2	9
65	BS	0	0	0	0	4	2	6
69	BM	1	1	1	7	16	2	26
76	BN	1	3	10	89	85	113	297
78	BAP	0	0	0	2	0	2	4
79	BH	0	0	0	0	1	0	1
81	*	0	0	0	0	0	1	1
83	BRC	0	0	2	1	3	0	6
84	BXN	0	0	0	0	0	1	1
86	*	0	0	0	0	1	0	1
87	BML	0	0	0	0	1	0	1
91	BEDT	0	0	0	0	1	0	1
92	CAD	0	0	0	0	0	1	1
97	CTN	0	0	0	0	1	0	1
99	CF	0	0	0	0	0	1	1
100	CWR	0	0	0	0	1	0	1
101	CI	0	0	0	0	1	1	2
103	CN	0	0	0	0	2	1	3
104	CBC	0	0	0	0	1	1	2
105	CP	1	1	0	1	0	0	1
106	CRN	0	0	0	0	0	1	1
108	*	0	0	0	0	0	1	1
109	*	0	0	0	4	4	2	10
111	CIC	0	0	0	0	2	0	2
112	CCT	0	0	0	0	1	0	1
113	CARR	0	0	0	0	0	1	1
114	CACV	0	0	0	0	1	0	1
117	CHR	0	0	0	0	1	0	1

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
118	CGA	0	0	1	2	8	19	30
119	CNJ	1	0	0	3	7	3	13
120	CV	1	1	0	2	3	1	6
124	CHV	0	0	0	0	1	1	2
125	CO	1	1	5	46	30	32	113
129	CEI	1	1	0	7	3	3	13
130	CIM	0	0	0	2	2	2	6
131	CNW	1	3	1	62	52	39	154
139	CHTT	0	0	0	1	1	2	4
140	MILW	1	3	3	47	42	53	145
141	CPLT	0	0	0	0	0	2	2
143	CRI	1	0	0	2	3	0	5
145	RI	1	3	2	27	34	40	103
147	CSL	0	0	0	0	1	0	1
150	CIW	0	0	0	0	1	0	1
153	CNTP	0	0	0	0	2	1	3
157	CS	1	3	0	2	4	6	12
158	CW	0	0	0	0	2	0	2
163	CLC	0	0	0	0	1	0	1
165	*	0	0	0	1	1	3	5
166	COP	0	0	0	0	1	0	1
168	CSS	0	0	0	0	0	1	1
169	CLP	0	0	0	0	1	0	1
177	CAGY	0	0	0	0	3	1	4
179	CHW	0	0	0	0	0	1	1
181	CLIF	0	0	0	0	0	1	1
186	CUVA	0	0	0	0	1	0	1
188	CLCO	0	0	0	0	1	0	1
191	DR	0	0	0	0	0	1	1
192	DRI	0	0	0	0	2	0	2
193	DVS	0	0	0	0	0	1	1
195	DH	1	1	0	9	11	3	23
196	DC	0	0	0	0	2	0	2
197	DRGW	1	3	1	3	6	20	30
200	DQE	0	0	0	0	0	2	2
201	CCR	0	0	0	0	1	0	1
202	DMU	0	0	0	1	0	0	1
204	DM	0	0	0	2	2	0	4
205	DTS	1	1	1	0	1	0	2
208	DTI	1	1	1	3	6	3	13
213	DMIR	1	3	0	3	4	2	9

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	TOTAL
215	CBL	0	0	0	2	2	0	4
216	DWP	1	3	0	0	1	0	1
217	DS	0	0	0	0	0	3	3
219	DT	0	0	0	1	0	1	2
220	DMM	0	0	0	0	1	0	1
222	CIRR	0	0	0	0	1	1	2
234	ETWN	0	0	0	0	0	1	1
238	EJE	1	1	1	3	4	5	13
240	EL	1	0	2	26	35	28	91
241	ELS	0	0	0	0	1	0	1
242	EACH	0	0	0	0	0	1	1
245	EJR	0	0	0	0	1	0	1
247	EDW	0	0	0	0	1	0	1
248	*	0	0	0	0	0	1	1
260	FPE	0	0	0	2	0	0	2
263	FEC	1	2	0	3	3	3	9
264	FJG	0	0	0	0	1	0	1
265	FP	0	0	0	0	0	1	1
268	FWD	1	3	0	5	0	5	10
273	FRDN	0	0	0	0	0	1	1
277	FWB	0	0	0	0	0	1	1
282	FDR	0	0	0	0	1	0	1
287	GCW	0	0	0	0	0	1	1
290	GM	0	0	0	0	0	1	1
293	GHH	0	0	0	3	1	1	5
298	GANO	0	0	0	0	0	1	1
299	GA	1	2	0	1	1	5	7
300	GSF	0	0	0	2	0	2	4
302	GRR	0	0	0	0	0	1	1
307	GNA	0	0	0	0	0	1	1
308	GTW	1	1	0	12	11	1	24
311	GWR	0	0	0	0	1	0	1
312	GBW	0	0	0	2	2	1	5
314	GMRC	0	0	0	2	1	0	3
319	GWIN	0	0	0	0	1	0	1
320	GNWR	0	0	0	0	1	0	1
321	GJ	0	0	0	0	1	0	1
323	GU	0	0	0	0	1	0	1
324	*	0	0	0	0	1	0	1
328	HE	0	0	0	0	0	1	1

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
329	HBS	0	0	0	0	1	0	1
331	HSW	0	0	0	0	0	1	1
334	HRT	0	0	0	0	1	0	1
337	*	0	0	0	0	1	0	1
340	*	0	0	0	2	3	4	9
341	*	0	0	0	0	0	1	1
350	ICG	1	2	4	47	48	33	132
352	*	0	0	0	0	1	0	1
354	ITC	1	1	0	4	2	0	6
357	IHB	0	0	3	4	4	1	12
359	*	0	0	0	1	3	0	4
364	IRN	1	0	0	0	0	1	1
366	HPTD	0	0	0	0	1	0	1
398	LAL	0	0	0	0	1	0	1
400	KCS	1	3	0	8	8	12	28
401	KCT	0	0	0	1	0	0	1
402	KIT	0	0	0	2	3	0	5
403	KENN	0	0	0	0	2	0	2
404	LT	0	0	0	2	0	0	2
407	LDRT	0	0	0	0	0	1	1
413	LNE	1	0	0	0	2	1	3
417	LSTT	0	0	0	1	0	0	1
419	LWV	1	0	0	0	2	0	2
420	LSBC	0	0	0	0	1	0	1
423	LEF	0	0	0	0	0	1	1
424	LEFW	0	0	0	0	0	1	1
425	LSI	0	0	0	1	3	1	5
426	LC	0	0	0	0	0	1	1
427	LRS	0	0	0	0	0	1	1
428	LAJ	0	0	0	1	0	0	1
429	LHR	1	0	0	2	0	0	2
430	LUN	0	0	0	0	0	1	1
431	LV	1	0	4	7	14	9	34
436	LI	1	1	1	1	2	0	4
441	LA	0	0	0	3	2	3	8
442	LNW	0	0	0	0	0	1	1
443	LPB	0	0	0	0	0	1	1
444	LN	1	2	4	28	54	25	111
445	LSD	0	0	0	0	0	1	1
446	LNAC	0	0	0	0	0	1	1

Table F-3 (Continued)

IRR	ARR	1976 CLASS C	REGION R	NUMBER OF YARDS NHM	NFC	NFI	NFS	TOTAL
447	LBR	0	0	0	0	0	1	1
450	LPN	0	0	0	1	0	1	2
451	LW	0	0	0	0	0	1	1
453	*	0	0	0	0	0	1	1
456	MEC	1	1	0	3	2	3	8
459	MJ	0	0	0	0	0	1	1
460	MRS	0	0	0	0	1	0	1
462	*	0	0	0	0	0	4	4
466	MCR	0	0	0	0	1	0	1
471	MSTR	0	0	0	0	1	0	1
475	MNJ	0	0	0	0	0	1	1
480	MNS	0	0	0	2	0	2	4
482	SOO	1	3	0	20	11	13	44
484	MTFR	0	0	0	0	1	0	1
490	MKT	1	3	0	13	3	17	33
493	*	0	0	0	0	0	1	1
494	MP	1	3	3	34	30	68	135
497	MGA	0	0	0	1	5	0	6
498	MCRR	0	0	0	0	1	0	1
500	MTR	0	0	0	0	1	1	2
502	MISS	0	0	0	0	0	1	1
506	MSE	0	0	0	0	1	1	2
507	MOV	0	0	0	0	0	1	1
509	MB	0	0	0	0	1	1	2
510	MDW	0	0	0	0	0	1	1
511	ME	0	0	0	0	1	0	1
513	IAT	0	0	0	0	2	0	2
515	MI	0	0	0	1	3	0	4
523	METW	0	0	0	0	0	1	1
524	*	0	0	0	0	1	0	1
525	NAP	0	0	0	0	0	1	1
530	NN	0	0	0	0	1	3	4
534	NLC	0	0	0	0	1	1	2
537	NEZP	0	0	0	0	0	1	1
542	NYD	0	0	0	0	1	0	1
546	NYSW	0	0	0	1	1	1	3
547	*	0	0	0	0	1	4	5
548	MCSA	0	0	0	0	0	1	1
549	NPB	0	0	0	1	1	1	3
550	NW	1	1	7	70	54	49	180

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
551	NS	0	0	0	2	3	4	9
552	MH	0	0	0	0	0	1	1
553	NLG	0	0	0	0	0	2	2
554	NB	0	0	0	0	1	0	1
559	NWP	1	3	0	1	1	5	7
560	*	0	0	0	0	1	0	1
561	*	0	0	0	0	1	0	1
577	NSS	0	0	0	1	0	2	3
582	NFD	0	0	0	1	1	0	2
586	OTR	0	0	0	0	1	0	1
587	OCTR	0	0	0	0	0	1	1
603	OCE	0	0	0	0	1	1	2
616	POV	0	0	0	0	1	0	1
619	PTM	0	0	0	1	1	0	2
622	PC	1	0	23	144	221	188	576
623	RDG	1	0	3	7	10	27	47
626	PLE	1	1	0	4	7	5	16
627	PS	0	0	0	1	1	2	4
629	PCY	0	0	0	1	2	0	3
631	PW	0	0	0	2	0	0	2
632	PRTD	0	0	0	2	0	0	2
634	PNW	0	0	0	0	1	0	1
644	PVS	0	0	0	0	0	1	1
645	PPU	0	0	0	2	2	1	5
647	PHD	0	0	0	1	0	0	1
648	PJR	0	0	0	1	1	0	2
651	PCN	0	0	0	0	0	1	1
655	QAP	0	0	0	0	0	2	2
656	QRR	0	0	0	0	0	1	1
659	PBNE	0	0	0	0	1	0	1
663	RFP	1	1	2	1	0	1	4
664	RV	0	0	0	0	1	0	1
665	RT	0	0	0	1	2	2	5
671	RR	0	0	0	0	2	0	2
673	RSP	0	0	0	0	1	0	1
675	RSS	0	0	0	0	0	1	1
678	SRN	0	0	0	0	0	1	1
682	SM	0	0	0	0	0	2	2
683	SJT	0	0	0	1	0	0	1
690	SLGW	0	0	0	0	0	1	1
691	SAN	0	0	0	0	0	1	1

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
693	SLSF	1	3	2	17	19	38	76
694	SSW	1	3	1	10	1	10	22
696	SLC	0	0	0	0	0	1	1
697	SN	0	0	0	0	2	3	5
700	*	0	0	0	0	0	1	1
702	SDAE	0	0	0	0	1	0	1
705	SLAW	0	0	0	0	0	1	1
706	SSLV	0	0	0	0	1	0	1
707	SS	0	0	0	0	0	1	1
709	TSU	0	0	0	0	1	0	1
712	SCL	1	2	3	38	88	51	180
716	SERA	0	0	0	0	0	1	1
718	SBK	0	0	0	0	1	0	1
719	*	0	0	0	0	1	0	1
720	SIND	0	0	0	0	0	2	2
721	SP	1	3	8	29	58	116	211
724	SOU	1	2	8	30	48	58	144
727	SI	0	0	0	1	1	3	5
730	*	0	0	0	1	1	0	2
739	STE	0	0	0	0	1	0	1
741	SMV	0	0	0	1	1	1	3
746	*	0	0	0	0	0	1	1
750	TEXC	0	0	0	0	0	1	1
755	TAG	0	0	0	0	0	1	1
757	TRRA	0	0	1	2	5	0	8
758	TASD	0	0	0	0	3	0	3
759	TMBL	0	0	0	1	0	0	1
760	TP	0	0	1	10	4	15	30
761	TCT	0	0	0	0	1	1	2
762	TM	1	3	0	2	0	1	3
765	TSE	0	0	0	0	1	0	1
767	TENN	0	0	0	0	1	0	1
769	TPW	1	3	0	1	1	5	7
771	TT	0	0	0	0	2	1	3
779	TRC	0	0	0	0	0	1	1
782	TOV	0	0	0	0	0	1	1
783	TCG	0	0	0	0	0	1	1
784	TS	0	0	0	0	0	1	1
785	TAW	0	0	0	0	0	1	1
788	TNM	0	0	0	0	0	1	1
793	SJL	0	0	0	1	1	0	2

Table F-3 (Continued)

		1976 CLASS	REGION	NUMBER OF YARDS				
IRR	ARR	C	R	NHM	NFC	NFI	NFS	ITOTAL
794	SMA	0	0	0	0	0	1	1
795	TN	0	0	0	0	1	0	1
799	SH	0	0	0	0	1	0	1
802	UP	1	3	4	31	31	70	136
803	URR	0	0	1	3	12	0	16
807	UT	0	0	0	0	1	0	1
808	UMP	0	0	0	0	2	0	2
809	UTR	0	0	0	0	0	1	1
811	UTAH	0	0	0	0	0	3	3
815	VAMD	0	0	0	0	0	2	2
817	VTR	0	0	0	1	2	1	4
826	WWV	0	0	0	0	0	1	1
828	WS	0	0	0	0	1	0	1
829	WOV	0	0	0	0	0	1	1
830	WYS	0	0	0	0	1	0	1
831	WIM	0	0	0	0	0	2	2
832	WSB	0	0	0	0	0	1	1
833	WYT	0	0	0	0	1	0	1
838	WRRC	0	0	0	0	0	1	1
839	WM	1	1	1	6	1	14	22
840	WP	1	3	0	5	6	10	21
841	WA	0	0	0	1	0	0	1
846	WSYP	0	0	0	0	0	1	1
848	WAG	0	0	0	0	2	0	2
850	WW	0	0	0	0	1	0	1
851	WNF	0	0	0	0	0	1	1
854	WSS	0	0	0	1	1	0	2
872	YVT	0	0	0	0	0	1	1
873	YW	0	0	0	0	0	1	1
875	YS	0	0	1	0	0	0	1
876	YAN	0	0	0	0	0	1	1
877	YN	0	0	0	0	2	0	2

Table F-4

TABULATION OF RAILROADS WHICH CHANGED ICC DESIGNATIONS BETWEEN 1976/77 AND 1978

Class I 1976/77 → Class II 1978

	UNIFORM ALPHA CODE	ACI CODE	RAILROAD NAME
1.	BAR	056	Bangor & Aroostook
2.	CP	105	Canadian Pacific
3.	CV	120	Central Vermong
4.	CEI	129	Missouri Pacific
5.	DTS	205	Detroit & Toledo Shore Line
6.	DWP	216	Duluth, Winnipeg & Pacific
7.	GA	299	Georgia
8.	ITC	354	Illinois Terminal
9.	MEC	456	Maine Central
10.	NWP	559	Northwestern Pacific
11.	RFP	663	Richmond, Fredericksburg & Potomac
12.	TM	762	Texas Mexican
13.	TPW	769	Toledo, Peoria & Western

Class II 1976/77 → Class I 1978

	UNIFORM ALPHA CODE	ACI CODE	RAILROAD NAME
1.	AGS	029	Alabama Great Southern
2.	CGA	118	Central of Georgia
3.	CNTP	153	Cincinnati, New Orleans & Texas Pacific
4.	LA	441	Louisiana & Arkansas

APPENDIX G

FRACTIONAL IMPACT PROCEDURE

An integral element of an environmental noise assessment is to determine or estimate the distribution of the population exposed to given levels of noise for given lengths of time. To assess the noise reduction impact of a proposed project or action, the existing noise exposure distribution of the population in the area affected should first be characterized by estimating the number of people exposed to different magnitudes of noise as described by metrics such as the Day-Night Average Sound Level (L_{dn}). Next, estimations or projections should be made of the distribution of people who may be exposed to noise levels generated after the adoption of various projected abatement alternatives. The environmental impact can be judged by simply comparing these successive population distributions. This concept is illustrated in Figure G-1 which compares the estimated distribution of the population prior to inception of a hypothetical project (Curve A) with the population distribution after implementation of the project (Curve B). For each statistical distribution, numbers of people are simply plotted against noise exposure where L_i represents a specific exposure in decibels to an arbitrary unit of noise. A measure of noise impact is ascertained by examining the shift in population distribution attributable either to increased or lessened project related noise. Such comparisons of population distributions allow us to determine the extent of noise impact in terms of changes in the number of people exposed to different levels of noise.

The intensity or severity of a noise impact may be evaluated by measuring the degree of noise exposure against suitable noise effects criteria, which exist in the form of dose-response or cause-effect relationships. Using these criteria, the probability or magnitude of an anticipated effect can be statistically predicted from knowledge of the noise exposure incurred. Illustrative examples of the different forms of noise effects criteria are graphically displayed in Figure G-2. In general, dose-response functions are statistically derived from noise effects information and exhibited as linear or curvilinear

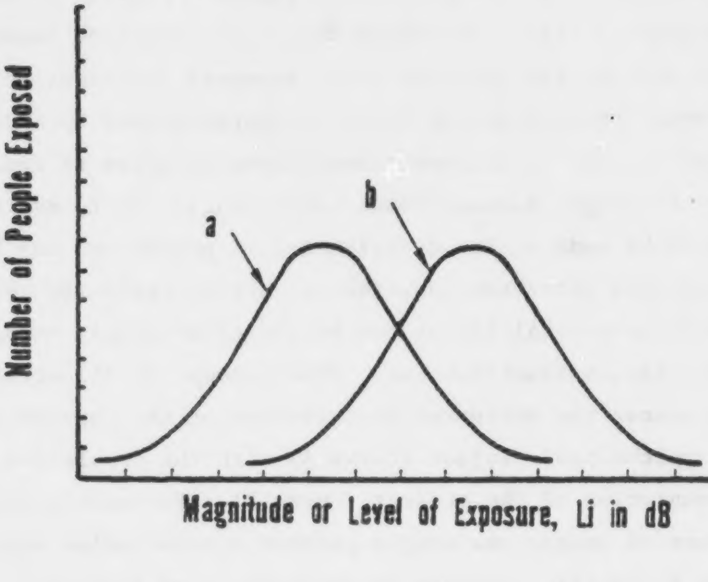
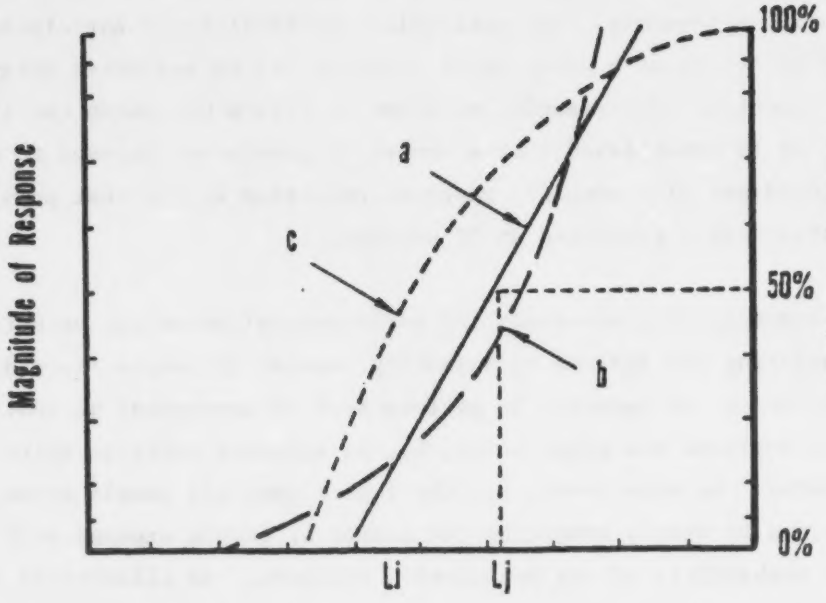


FIGURE G-1. EXAMPLE ILLUSTRATION OF THE NOISE DISTRIBUTION OF POPULATION AS A FUNCTION OF NOISE EXPOSURE



(a) LINEAR, (b) POWER, (c) LOGARITHMIC

FIGURE G-2. EXAMPLE OF FORMS OF NOISE EFFECTS CRITERIA relationships, or combinations thereof. Although these relationships generally represent a statistical "average" response, they may also be defined for any given population percentile. The statistical probability or anticipated magnitude of an effect at a given noise exposure can be estimated using the appropriate function. For example, as shown in Figure G-2 using the linear function, if it is established that a number of people are exposed to a value of L_j, the incidence of a specific response occurring within that population would be statistically predicted at 50 percent.

A more comprehensive assessment of environmental noise may be performed by cross-tabulating the indices of extensity (number of people exposed) and intensity (severity) of impact. To perform such an assessment we must first statistically estimate the given level, L_i, by applying suitable noise effects criteria. At each level, L_i, the impact upon all people so exposed is then obtained by simply comparing the number of people exposed with the magnitude or probability of the anticipated response. As illustrated in Figure G-1, the extent of a noise impact is functionally described as a distribution of exposures. Thus, the total impact of all exposures is a distribution of people who are affected to varying degrees. This may be expressed by using an array or matrix in which the severity of impact at each L_i is plotted against the number of people exposed at that level. Table G-1 presents a hypothetical example of such an array.

Table G-1

EXAMPLE OF IMPACT MATRIX FOR A HYPOTHETICAL SITUATION

Exposure	Number of People	Magnitude or Probability of Response in Percent
L_i	1,200,000	4
L_{i+1}	900,000	10
L_{i+2}	200,000	25
L_{i+3}	50,000	50
...		
L_{i+n}	2,000	85

An environmental noise assessment usually involves analysis, evaluation and comparison of many different planning alternatives. Obviously, creating multiple arrays of population impact information is quite cumbersome, and subsequent comparisons between complex data tabulations generally tend to become somewhat subjective. Clearly, what is required is a single value which interprets the environmental noise impact and which incorporates both attributes of extensity and intensity of impact. Accordingly, the National Academy of Sciences, Committee on Bioacoustics and Biomechanics (CHABA) has recommended a procedure for assessing environmental noise impact which mathematically takes into account both extensity and intensity of impact.[1] This procedure, the fractional impact method, computes total noise impact by simply counting the number of people exposed to noise at different levels and statistically weighting each person by the intensity of noise impact. The result is a single number value which represents the overall magnitude of the impact.

The purpose of the fractional impact analysis methods is to quantitatively define the impact of noise upon the population exposed. This, in turn, facilitates trade-off studies and comparisons of the impact between different projects or alternative solutions. To accomplish an objective comparative environmental analysis, the fractional impact method defines a series of "partial noise impacts" within a number of neighborhoods or groups, each of which is exposed to a different level of noise. The partial noise impact of each neighborhood is determined by multiplying the number of people residing within the neighborhood by the "fractional impact" of that neighborhood, i.e., the statistical probability or magnitude of an anticipated response as functionally derived from relevant noise effects criteria. The total community impact is then determined by simply summing the partial impacts of all neighborhoods.[1]

It is quite possible, and in some cases very probably, that a large proportion of a noise impact may be found in subneighborhoods which are exposed to noise levels of only moderate value. Although people living in proximity to a noise source are generally more severely impacted than those people living further away, this does not imply that the latter should be totally excluded from an assessment where the purpose is to objectively and quantitatively evaluate the magnitude of a noise impact. People exposed to lower levels of noise may still experience an adverse impact, even though that impact may be small in magnitude. The fractional impact method considers the total impact upon all people exposed to noise recognizing that some individuals incur a significantly greater noise exposure than others. The procedure duly ascribes more importance to the more severely affected population.

As discussed previously, any procedure which evaluates the impact of noise upon people or the environment, as well as the health and behavioral consequences of noise exposure and resultant community reactions, must encompass two basic elements of that impact assessment. The impact of noise may be intensive (i.e., it may severely affect a few people) or extensive (i.e., it may affect a larger population less severely). Implicit in the fractionalization concept is that the magnitude of human response varies proportionately with the degree of noise exposure, i.e., the greater the exposure, the more significant the response. Another major assumption is that a moderate noise exposure for a large population has approximately the same noise impact upon the entire community as would a greater noise exposure upon a smaller number of people. Although this may be conceptually envisioned as a trade-off between the intensity and extensity of noise impact, it would be a misapplication of the procedure to disregard those persons severely impacted by noise in order to enhance the environment of a significantly larger number of people who are affected to a lesser extent. The fact remains, however, that exposing many people to noise of a lower level would have roughly the same impact as exposing a fewer number of people to a greater level of noise when considering the impact upon the community or population as a whole. Thus, information regarding the distribution of the population as a function of noise exposure should always be developed and presented in conjunction with use of the fractional impact method.

Because noise is an extremely pervasive pollutant, it may adversely affect people in a number of different ways. Certain effects are well documented. Noise can:

- cause damage to the ear resulting in permanent hearing loss,

- o interfere with spoken communication,
- o disrupt or prevent sleep,
- o be a source of annoyance.

Other effects of noise are less well documented but may become increasingly important as more information is gathered. They include the nonauditory health aspects as well as performance and learning effects.

It is important to note, however, that quantitatively documented cause-effect relationships which functionally characterize any of these noise effects may be applied within a fractionalization procedure. The function for weighting the intensity of noise impact with respect to general adverse reaction (annoyance) is displayed in Figure G-3.[1] The nonlinear weighting function is arbitrarily normalized to unity at $L_{dn} = 75$ dB. For convenience of calculation, the weighting function may be expressed as representing percentages of impact in accordance with the following equation:

$$W(L_{dn}) = \frac{[3.364 \times 10^{-6}]\ [10^{0.103\ L_{dn}}]}{[0.2]\ \ [10^{0.03\ L_{dn}}] + [1.43 \times 10^{-4}]\ [10^{0.08\ L_{dn}}]} \qquad (1)$$

A simpler linear approximation that can be used with reasonable accuracy in cases where day-night average sound levels range between 55 and 80 dB is shown as the dashed line in Figure G-3 and is defined as:

$$W(L_{dn}) = \begin{cases} 0.05\ (L_{dn} - 55) & \text{for } L_{dn} \geq 55 \\ 0 & \text{for } L_{dn} < 55 \end{cases} \qquad (2)$$

Using the fractional impact concept, an index referred to as the Equivalent Noise Impact (ENI)* may be derived by multiplying the number of people exposed to a given level of noise by the fractional or weighted impact associated with that level as follows:

$$ENI_i = W(L_{dn}{}^{i}) \quad P_i \qquad (3)$$

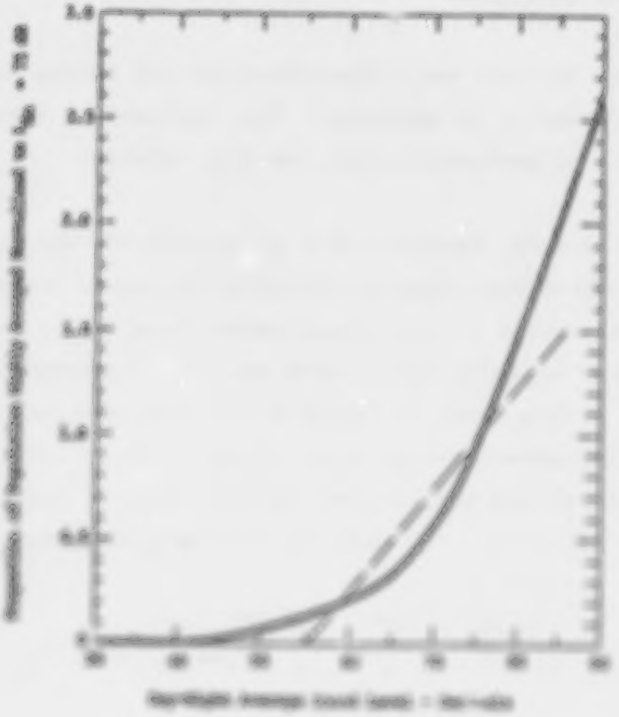


FIGURE [illegible] WEIGHTING FUNCTION FOR ASSESSING THE
GENERAL ADVERSE RESPONSE TO NOISE

where ENI_i is the magnitude of the impact on the population exposed at L_{dn}^i, $W(L_{dn}^i)$ is the fractional weighting associated with a noise exposure of L_{dn}^i and P_i is the number of people exposed to L_{dn}^i.

Because the extent of noise impact is characterized by a distribution of people all exposed to different levels of noise, the magnitude of the total impact may be computed by determining the partial impact at each level and summing over each of the levels. This may be expressed as:

$$ENI = \sum_i ENI_i = \sum_i W(L_{dn}^i) \quad P_i \tag{4}$$

The average severity of impact over the entire population may be derived from the Noise Impact Index (NII) as follows:

$$NII = \frac{ENI}{P_{total}} \tag{5}$$

Another concept, the Relative Change in Impact (RCI) is useful for comparing the relative difference between two alternatives. This concept takes the form expressed as a percent change in impact:

$$RCI = \frac{ENI_1 - ENI_2}{ENI_1} \tag{6}$$

where ENI_1 and ENI_2 are the calculated impacts under two different conditions.

An example of the fractional impact calculation procedure is presented in Table D-1.

The other indices are conceptually identical to the ENI notation.

Similarly, using relevant criteria, the fractional impact procedure may be utilized to calculate relative changes in hearing damage risk, sleep disruption and speech interference.

(Adapted, in part, from Goldstein, J. "Assessing the Impact of Transportation Noise: Human Response Measures", Proceedings of the 1977 National Conference on Noise Control Engineering. G.C. Maling (ed.), NASA Langley Research Center, Hampton, Virginia, 17-19 October 1977, pp. 79-88).

REFERENCES

1. Guidelines for Preparing Environmental Impact Statements on Noise National Academy of Sciences, Committee on Bioacoustics and Biomechanics Working Group Number 69, February 1977.

Table [illegible]

EXAMPLE OF PRACTICAL [illegible]

(1)	(2)	(3)	(4)	(5)	(6)	(7)
[illegible]	[illegible]	N_j	$\Phi(I_{dj})$ (Curvilinear)	$\Phi(I_{dj})$ (Linear approx)	ENI_j (Curvilinear) (Column (3) x (4))	ENI_j (Linear) (Column (3) x (5))
[illegible]	[illegible]	1,200,000	0.173	0.125	207,600	150,000
[illegible]	[illegible]	900,000	0.314	0.375	282,600	337,500
[illegible]	[illegible]	200,000	0.528	0.625	105,600	125,000
[illegible]	[illegible]	50,000	0.822	0.875	41,100	43,750
[illegible]	[illegible]	10,000	1.202	1.125	12,020	11,250
		2,360,000			648,920	667,500

ENI (Curvilinear) = 648,920

ENI (Linear) = 667,500

[illegible] (Curvilinear) = 648,920 ÷ 2,360,000 = 0.27

[illegible] (Linear) = 667,500 ÷ 2,360,000 = 0.28

APPENDIX H

RAILCAR COUPLING NOISE MEASUREMENTS

1. Introduction

One of the major sources of noise in railroad yards is the coupling of railcars during routine classification operations. However, the data base of the noise levels generated during such operations is not very extensive -- particularly in terms of the effect of various parameters on the resulting noise level, such as the car-coupling speed, the types of cars involved in the coupling, their weights, whether they are loaded or unloaded, etc. For this reason, a limited series of experiments has been conducted to obtain measured noise levels during a variety of controlled car couplings.

The tests were conducted at the DARCOM Ammunitions Center in Savanna, Illinois, on 6 December 1978. The tests were designed primarily to investigate the effect of speed and car type and weight on the noise level generated during the car coupling. Noise levels were measured for six speeds between two and eight miles per hour, for each of five different configurations of railcars.

This appendix documents the results of these tests as well as test procedures and measurements. Tables H-4 and H-5 present actual car coupling speed data collected by Conrail which was used as a guide in formulating the car coupling standard. Attachments H-1 through H-4 contain information and correspondence on industry car coupling rules and practices (see p. H-33).

2. Experimental Design

A total of 30 tests were conducted. Each test consisted of a single "test car" coupling with a string of one or more "buffer cars". For the first three sets of measurements, five empty box cars were used as the [illegible] two sets of measurements, the fully-loaded coal car served as the buffer the test cars. For these five configurations, tests were conducted for each of the following (nominal) speeds: 2, 3, 4, 5, 6 and 8 miles per hour.

The final configuration involved one empty box car coupling with four empty box cars at a nominal speed of 4 miles per hour. Four tests were conducted: one test with the buffer cars stretched apart so that there was no slack in any of the couplers; one test with the buffer cars pushed together for maximum coupler slack and two tests with the buffer cars having random slack.

Each test proceeded as follows: The switch engine pushed the test car toward the buffer cars. When the engine and railcar had achieved the proper speed and were close enough to the buffer cars, the engine was braked, causing the test car to uncouple from it and proceed alone toward the buffer cars. Just before coupling with the buffer cars the speed of the test car was measured. As the test car coupled with the buffer cars, noise levels were measured at several locations nearby. After the test was concluded, the engine recoupled with the test car and pulled it and the attached buffer cars back so that the buffer cars were in their original position. The buffer cars were then uncoupled from the test car, and the engine and test car would retreat.

The speed of the test car immediately prior to coupling with the buffer cars was measured by timing the period between the closure of two switches located 5.0 meters apart on the track as the test car passed by the switches. These speed measurements were performed by the [illegible] Center staff and reported immediately after each test.

Noise data were collected at three locations (A, B and C) as shown in [illegible]

In addition, at Location A a sound level meter was included to provide a

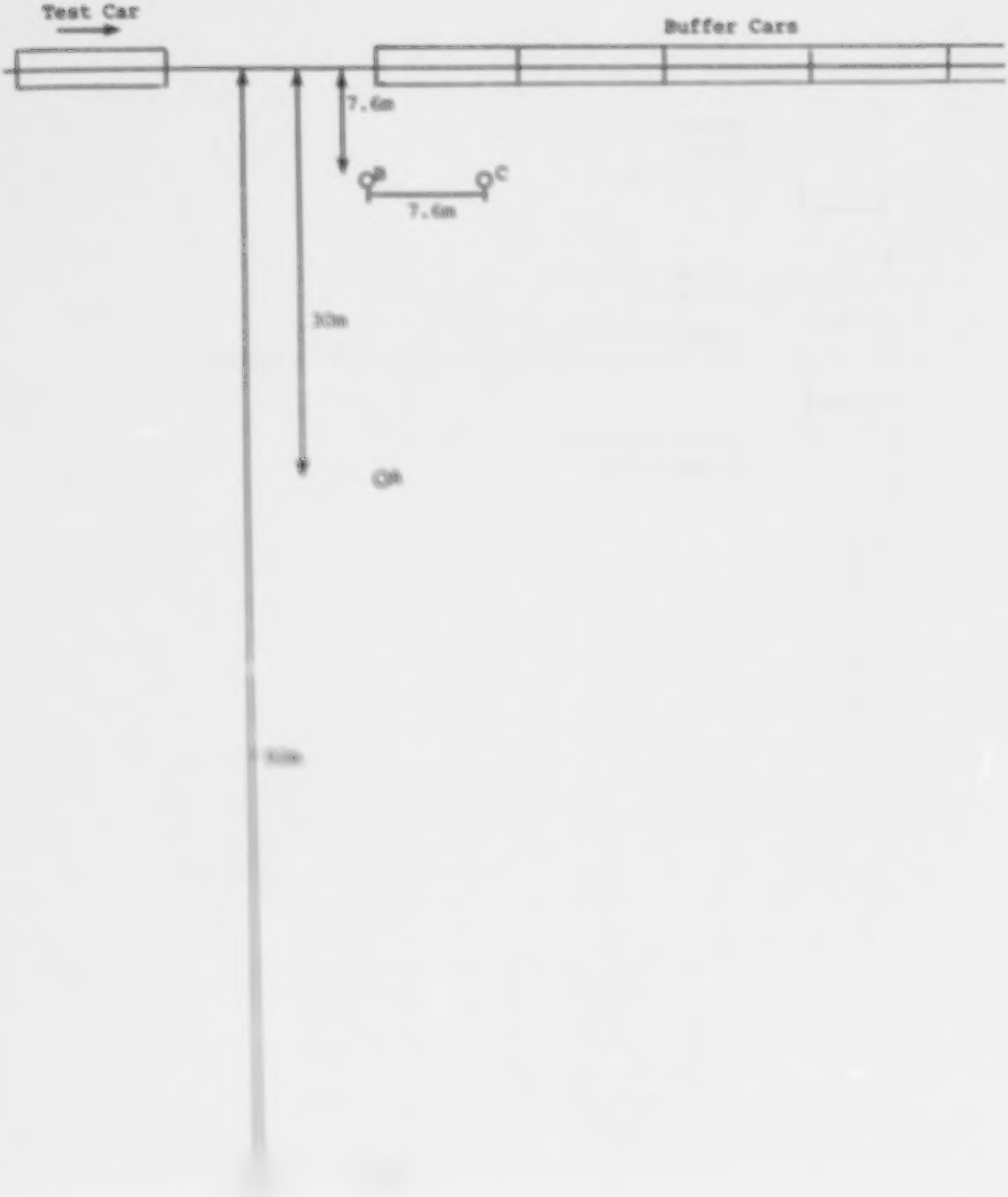


FIGURE B-1. NOISE MEASUREMENT LOCATIONS

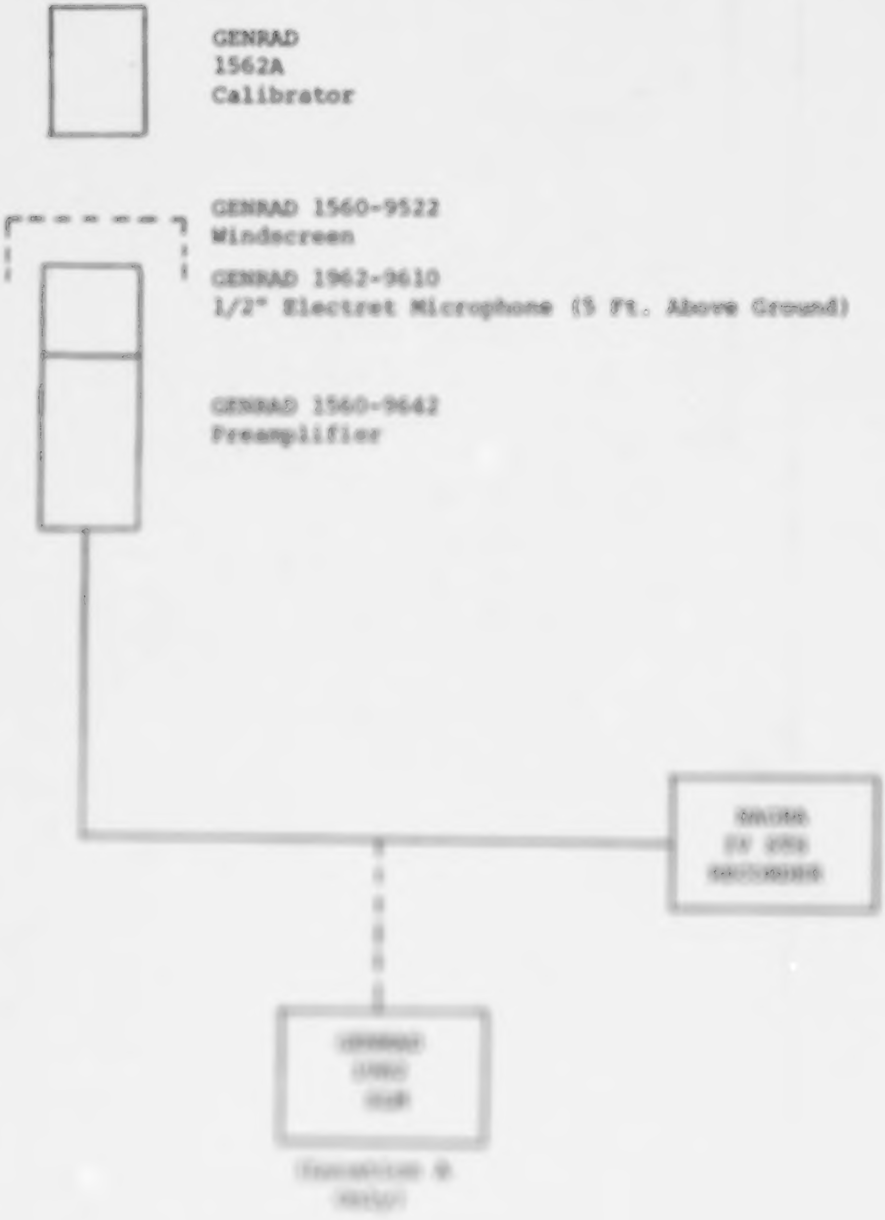


FIGURE B-2. SCHEMATIC OF NOISE MEASUREMENT INSTRUMENTATION direct reading of the maximum level occurring during the test. Two additional sets of measurements were obtained by EPA personnel, one at location B and one at location D as shown in Figure H-1.

During the measurements, calibration signals were applied at regular intervals to provide a standard for the measured data and to check the operating stability of the instrumentation.

The temperature and wind direction and magnitude were also measured at regular intervals. During the day of testing the temperature varied from 19 to 22°F, and the wind varied from calm to 8 mph (with gusts to 12 mph). The sky was generally overcast, and the ground was snow-covered.

3. Measurement Results

The recorded noise levels at each measurement location (A, B and C) were played back into a sound level meter to obtain the maximum A-weighted sound level for both slow and fast dynamic response and into an integrating sound level meter to obtain the sound exposure level (see Figure H-3 for a diagram of the playback instrumentation). Table H-1 lists these two maximum values (L_{max}: slow and fast) and the sound exposure level (SEL) for each measurement location for each of the 33 tests. Also shown on the table are the maximum levels read directly in the field by EPA personnel at location D. The car-coupling speed measured during each test by the [illegible] personnel is listed on the table as well.

For the five test configurations for which the noise level was measured at each of six different speeds (tests 1 through 30), Figure H-4 shows the maximum A-weighted slow noise level plotted as a function of speed. Figure H-5 is a similar plot, for the maximum A-weighted fast noise level. These two

[illegible]

speed, V, as follows:

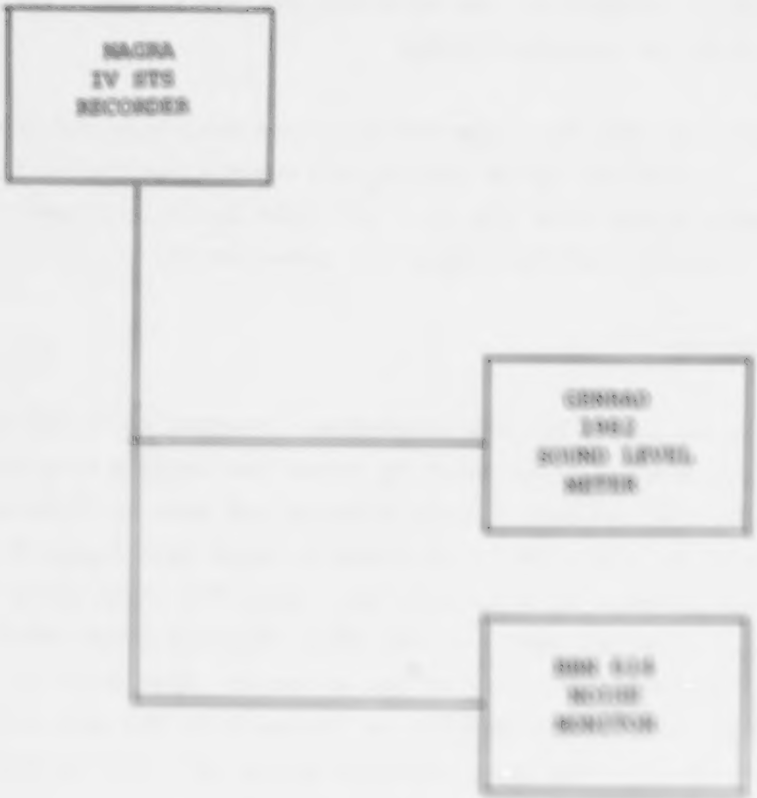


FIGURE B-3. SCHEMATIC OF DATA PROCESSING INSTRUMENTATION

Table D-1

MEASURED A-WEIGHTED NOISE LEVELS[1] DURING COUPLING TESTS

	Position A			Position B			Position C			Position A	Position D[4]
…lin …ed[2] …h	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow[3]	L_{max} Fast[3]
…PTY	…AR COUPLING WITH FIVE EMPTY BOX CARS										
71	83.2	85.8	77.2	91.7	100.5	94.3	90.2	97.3	87.1	(80.6)[6]	68.3
17	85.3	86.3	77.3	94.2	102.1	94.8	90.2	97.9	87.7	80.7	70.2
13	85.1	92.8	86.0	98.4	108.0	98.2	95.2	104.3	95.6	85.6	74.9
18	(88.2)[5]	–	–	99.6	107.6	100.1	96.9	105.7	98.6	88.7	76.7
13	(93.4)[5]	–	–	101.9	110.1	102.3	98.9	107.7	100.3	90.9	81.0
11	(96.3)[5]	–	–	107.6	115.3	108.0	105.6	115.2	106.6	96.7	88.0
…OADE	…CAR COUPLING WITH FIVE EMPTY BOX CARS										
15	85.8	88.7	78.3	91.7	101.5	92.4	90.6	101.3	88.1	80.4	72.0
28	88.2	93.7	85.5	95.6	103.9	95.8	94.6	103.7	95.0	85.1	75.0
40	89.1	95.8	94.0	99.1	107.3	99.7	98.0	106.5	99.7	(89.8)[6]	79.9
49	91.8	98.4	95.7	102.1	110.5	102.1	102.1	111.7	103.1	92.6	82.7
34	93.8	99.8	96.6	104.3	112.0	104.4	103.9	112.3	105.0	94.5	85.4
19	96.1	103.8	98.5	106.9	114.3	106.4	106.3	114.9	106.6	96.0	87.4
…OADE	…CAR COUPLING WITH FIVE EMPTY BOX CARS										
11	83.8	88.1	81.1	93.4	101.4	93.0	90.3	101.5	87.9	82.0	73.4
07	85.6	92.8	86.2	95.3	103.8	95.4	95.1	104.5	96.0	85.7	75.3
00	88.3	96.8	92.2	100.1	107.5	101.6	99.6	108.9	100.8	90.1	81.3
18	92.8	99.2	94.5	103.0	111.5	103.6	102.6	112.7	103.6	93.1	82.4
48	95.4	102.3	97.1	104.8	114.3	106.5	105.8	115.9	106.1	96.1	87.3
13	98.8	105.7	103.1	106.7	117.1	104.6	110.2	119.5	110.4	98.8	89.6

Table B-1

MEASURED A-WEIGHTED NOISE LEVELS[1] DURING COUPLING TESTS (Continued)

upl peed mph	Position E			Position B			Position C			Position A	Position D[4]
	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow	L_{max} Fast	SEL	L_{max} Slow[3]	L_{max} Fast[3]
EMP	CAR COUPLING WITH ONE LOADED COAL CAR										
.30	[illegible]	[illegible]	[illegible]	95.7	102.3	96.0	90.3	100.4	89.9	83.1	73.2
.06	([illegible])[2]	-	-	96.0	104.5	96.0	90.7	100.4	90.3	83.9	75.7
4.24	[illegible]	[illegible]	[illegible]	99.6	108.7	99.9	94.7	104.8	95.5	87.3	79.0
.11	[illegible]	[illegible]	[illegible]	101.7	110.7	102.7	96.1	105.2	97.8	88.1	78.7
-	[illegible]	[illegible]	[illegible]	104.5	112.0	105.1	99.3	108.1	100.2	91.9	83.2
.34	[illegible]	[illegible]	[illegible]	104.7	114.2	105.1	100.0	112.2	100.8	91.9	83.0
.04	[illegible]	[illegible]	[illegible]	107.7	114.5	108.1	102.4	111.9	103.2	96.1	86.1
LOA	CAR COUPLING WITH ONE LOADED COAL CAR										
.01	[illegible]	[illegible]	[illegible]	92.3	102.5	90.9	87.5	100.6	91.2	78.7	68.5
.87	[illegible]	[illegible]	[illegible]	97.7	106.6	97.1	92.0	101.0	92.0	84.7	74.7
4.04	[illegible]	[illegible]	[illegible]	98.7	107.0	99.1	94.2	104.4	95.0	86.5	76.2
.08	[illegible]	[illegible]	[illegible]	106.5	117.9	105.1	100.5	112.8	100.0	92.8	80.4
.14	[illegible]	[illegible]	[illegible]	107.1	117.1	106.3	101.6	113.6	101.3	94.4	83.6
.17	[illegible]	[illegible]	[illegible]	107.9	118.2	-	102.3	114.4	102.1	96.3	85.0
EMP	CAR COUPLING WITH FOUR EMPTY BOX CARS										
4.11	[illegible]	[illegible]	[illegible]	98.9	106.3	99.7	95.2	103.7	96.3	86.9	77.2
4.04	[illegible]	[illegible]	[illegible]	99.0	106.2	99.9	94.8	103.3	95.9	86.1	76.8
4.15	[illegible]	[illegible]	[illegible]	99.8	106.2	100.6	96.5	104.8	97.8	88.8	79.7
.91	[illegible]	[illegible]	[illegible]	98.8	105.9	99.5	96.1	104.7	97.2	87.6	76.7

oise are in units of dBA.

ling were measured by [illegible] Center staff.

lev [illegible] columns were read directly in the field; all other levels were determined

reco

lev Position D were measured by EPA Regional staff.

nsi [illegible] were estimated from the levels read directly in the field.

nsi [illegible] were estimated from the recorded noise data.

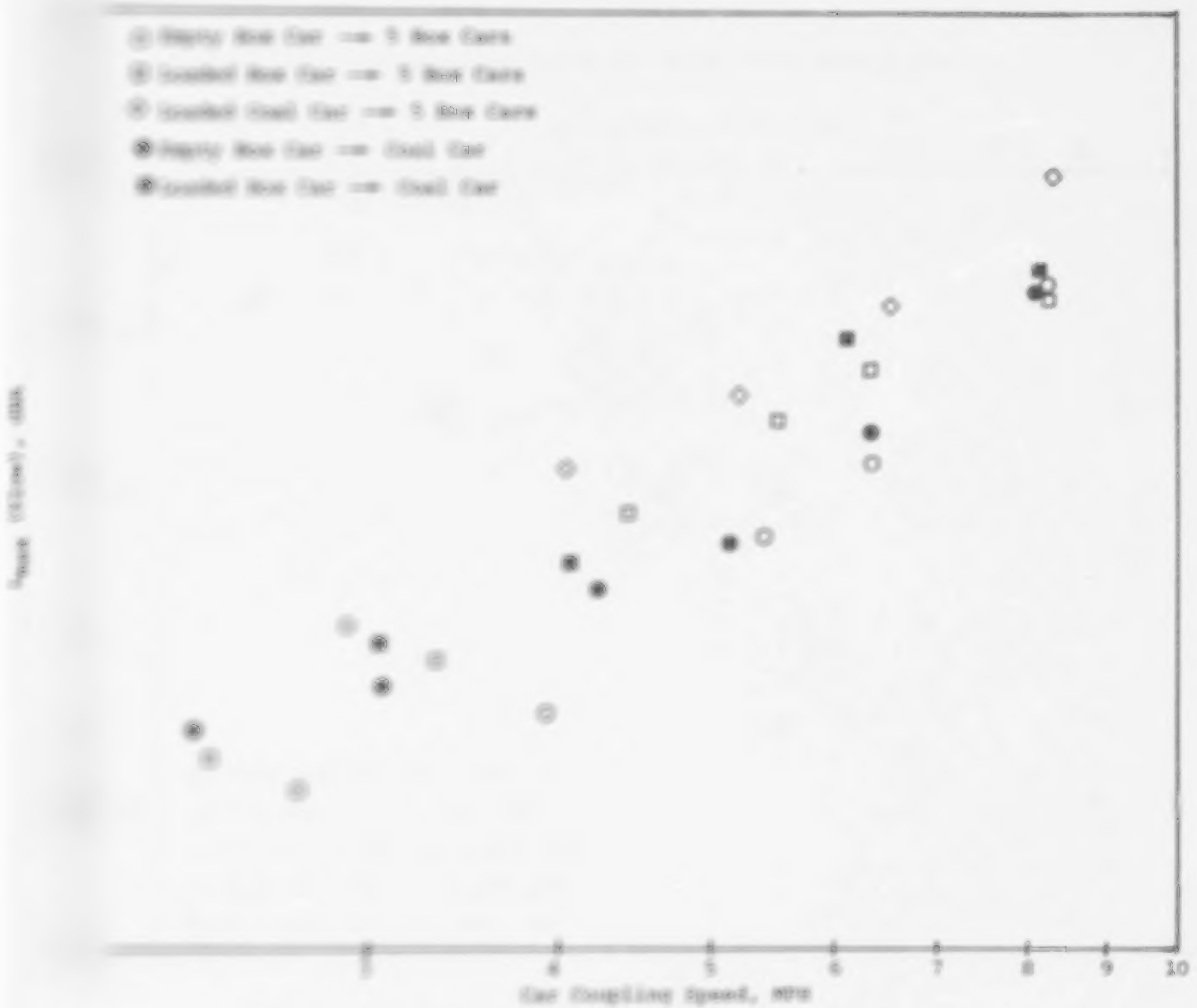


FIGURE 3-6. MAXIMUM NOISE LEVELS VS. SPEED (Slow Meter Dynamics)

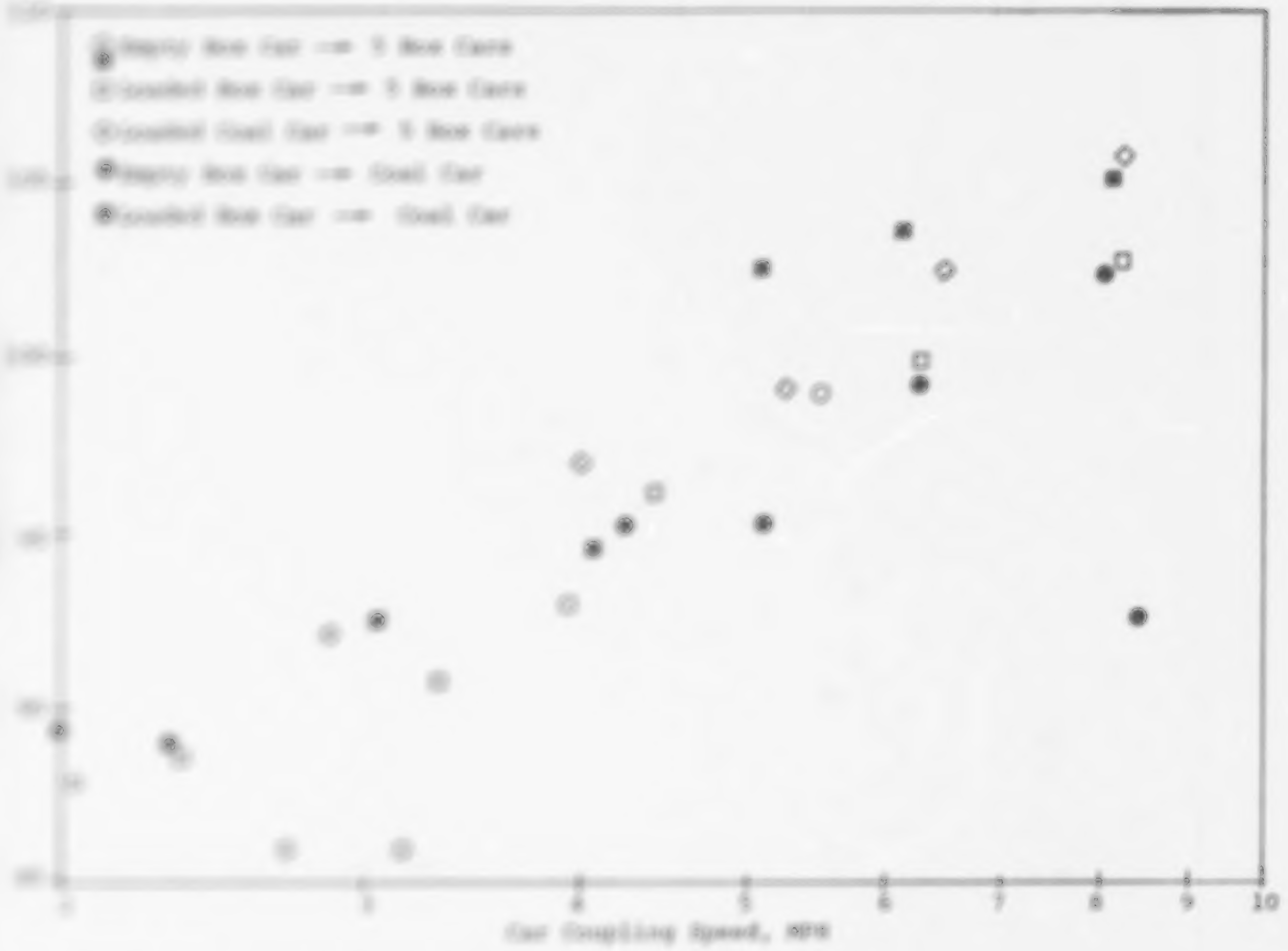


FIGURE [illegible]. MAXIMUM NOISE LEVELS VS. SPEED (Fast Meter Dynamics)

$L_{max} = A + B \log V$, where V is in mph and the quantities "A" and "B" are constants. "B", the slope of the line through the data points, is on the order of 30 for both Figures H-4 and H-5. "A" will vary with the car configuration.

For the first three configurations in which different test cars coupled with five empty box cars, the maximum noise level at any speed appears to increase with the weight of the test car (Table H-2 lists the weights of all test and buffer cars used during the measurements). For the two configurations with the loaded coal car as the buffer car, the noise levels for several tests are near the levels measured when the buffer cars are the five empty box cars (particularly for the slow data). Since the weight of the loaded coal car is nearly identical to the weight of the five empty box cars, the noise level appears to be more a function of weight than of buffer car type or configuration. The highest overall noise levels generally occurred when the loaded coal car coupled with the five empty box cars.

Even though the variation of level with car weight can be seen from the data in Figures H-4 and H-5, the actual range in levels at any given speed is not very large: 5 to 7 dB at the lower speeds and 2 to 4 dB at the upper speeds. This implies that for other configurations with different cars than those measured under these tests, if the weights are comparable the noise levels will probably lie within the same general range.

By examining the average value of the differences between two sets of data, and the associated standard deviation about that average, conclusions can be drawn concerning the relationships between the two data sets. Table H-3 lists such averages and standard deviations for a variety of sets of data. First, differences between the levels measured at locations B and C are examined. The noise levels (slow) at location C are consistently lower than at location B, with an average difference of more than 3 dB. This implies that the maximum noise during the coupling activity is generated at the coupler itself, and not from any secondary radiation from the car body.

Comparison of the 30 and 92 meter slow noise data shows an average difference of 9.8 dB. For a point source, one would expect a change in

Table H-2
MASS OF RAIL CARS USED IN TESTS

CAR(S)	MASS, KILOGRAMS
Empty Box Car	20,045
Loaded Box Car	63,988
Loaded Coal Car	100,000
5 Empty Box Cars	103,590
4 Empty Box Cars	83,636

Table H-3
ANALYSIS OF DIFFERENCES BETWEEN SETS OF CAR COUPLING NOISE LEVELS

DATA SETS	AVERAGE DIFFERENCE, dB	STANDARD DEVIATION, dB	NO. OF SAMPLES
L_{max} at Location B - L_{max} at Location C (slow)	3.1	2.1	35
L_{max} at Location A - L_{max} at Location D (slow)	9.8	1.1	35
L_{max} Fast - L_{max} Slow	8.5	1.5	101
L_{max} Slow - SEL	- 0.6	1.6	100
L_{max} Fast - SEL	7.9	2.4	100

level of 9.5 dB between measurement positions located 30 and 92 meter from the source. This is indeed shown to be the case for car-coupling noise.

Comparison of the maximum levels determined using fast versus slow dynamic response of the sound level meter shows an average difference of 8.5 dB. Based upon the fast and slow dynamics, this implies that the car-coupling noise has a typical duration on the order of 1/10 of a second. The small standard deviation (1.5 dB) also implies that one can estimate the slow level from measurement of the fast, and vice versa, with reasonable accuracy.

Similarly, the small standard deviation in the difference between the SEL values and slow max levels also indicates that estimates of one quantity based upon measurements of the second can be made with reasonable accuracy. This is of particular interest since measurement of the maximum level is generally less costly to obtain than measurement of the SEL value. Estimation of the SEL can also be based on measurement of the fast max levels, but with somewhat lower accuracy (since the standard deviation is higher).

With regard to the last four measurements (tests 31 through 34), Table H-1 shows that there is minimal difference in the noise level generated when the buffer cars are compressed versus stretched versus randomly positioned. Although the number of measurements is in reality too small to draw statistically significant conclusions, the condition of the buffer cars with regard to being stretched or compressed does not appear to be an important variable in influencing the coupling noise level.

Comparison of the maximum levels measured at location B for the last four tests, all conducted at the same nominal speed, indicates that there is a rather small variability (1 dB) in repeat runs of the same (or nearly the same) configuration. At location A the variability is somewhat higher; this may be due to meteorological effects which would be more pronounced as the distance from the source to the microphone increases.

Table H-4

SUMMARY OF CONRAIL SYSTEM CAREFUL CAR HANDLING PROGRAM*

Coupling Speed (mph)			Average Coupling Speed	Frequency of Car Coupling	Weighted Average Car Coupling Speed
X_1		X_2	$\bar{X}$	f	$f\bar{X}$
0.0	-	0.9	.5	52	26.0
1.0	-	1.9	1.5	2147	3220.5
2.0	-	2.9	2.5	5606	14015.0
3.0	-	3.9	3.5	10889	38111.5
4.0	-	4.9	4.5	15589	70150.5
5.0	-	5.9	5.5	16433	90381.5
6.0	-	6.9	6.5	6143	39929.5
7.0	-	7.9	7.5	2380	17850.0
8.0	-	8.9	8.5	1087	9239.5
9.0	-	9.9	9.5	407	3866.5
10.0	-	10.9	10.5	139	1459.5
11.0	-	11.9	11.5	54	621.0
12.0	-	12.9	12.5	14	175.0
13.0	-	13.9	13.5	12	162.0
14.0	-	14.9	14.5	4	58.0
15.0	-	15.9	15.5	1	15.5
17.0	-	17.9	17.5	1	17.5
			Total	60958	289,299.0

Total Impact Average $= \frac{f\bar{X}}{n} = \frac{289,299.0}{60958} = 4.75$ Average Coupling Speed of cars which made coupling

Total Overspeed Average $= \frac{f\bar{X}}{n} = \frac{73394}{10242 \text{ (Cars over 6mph)}} = 7.17$ (Average)

---

*Measurements taken third and fourth quarter 1978, first and second quarter 1979.

Table H-5

SUMMARY OF CONRAIL CAR COUPLING SPEED DATA BY QUARTERS

Speed Frequency	Total	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	Stall
3rd Qtr.1978	7173	2	303	809	1300	1619	1489	706	283	108	40	9	4	-	1	500
4th Qtr.1978	6970	3	297	625	1193	1751	1763	619	205	85	45	9	-	1	5	369
1st Qtr.1979	7682	6	331	731	1328	1935	1769	656	261	178	57	17	5	1	1	406
2nd Qtr.1979	7772	-	279	635	1372	1988	2004	718	268	114	33	19	11	2	5	324
A Total*	29,597	11	1210	2800	5193	7293	7025	2699	1017	485	175	54	20	4	12	1599
3rd Qtr.1978	5583	11	184	440	1004	1229	1353	593	256	124	67	13	17	1	1	290
4th Qtr.1978	4987		141	404	818	1282	1187	494	215	55	28	9	1	-	3	249
1st Qtr.1979	5115	2	204	613	754	1205	1263	498	196	98	32	20	3	4	1	222
4th Qtr.1979	6753	-	127	463	1062	1700	1970	680	281	140	51	26	9	3	-	241
B Total*	22,438	14	656	1920	3688	5416	5873	2265	948	417	178	68	30	8	5	1002
3rd Qtr.1978	3209	17	115	277	543	614	803	380	149	77	23	9	-	1	-	141
4th Qtr.1978	2084	-	36	115	376	554	596	208	66	38	9	4	-	-	1	81
1st Qtr.1979	2395	9	47	192	495	706	624	131	58	25	7	2	2	-	-	97
2nd Qtr.1979	4256	1	83	302	644	946	1512	410	142	45	15	2	2	1	-	101
C Total*	11,944	27	281	886	2058	2880	3535	1179	415	185	54	17	4	2	1	420
Total	63,979	52	2147	5606	10889	15587	16433	6143	2380	1087	407	139	54	14	18	3021
% of Total Sample		.001	.034	.088	.170	.244	.257	.096	.037	.017	.006	.002	.001	-	-	.047

*A - daytime hours (7am - 3pm); B - afternoon hours (3pm - 11pm); C - nighttime hours (11 pm - 7am)

REFERENCES

1. Bolt Beranek and Newman, Inc.; Report No. 3873, 1978, Cambridge, Massachusetts.

Preface to Attachments H-1 through H-4

The Agency solicited information from rail carriers regarding their operating rules, operating practices or recommended practices concerning locomotive and rail car coupling speeds (Attachment H-1). The Association of American Railroads (Attachment H-2), as well as some eighty(80) rail carriers responded to our request for information (Attachment H-3). Attachment H-4 provides a summary of these responses.

Attachment H-1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Dear

The Environmental Protection Agency (EPA) is in the process of broadening the scope of its railroad noise emission standards to include interstate rail carriers' equipment and facilities. This action was ordered by the United States Court of Appeals for the District of Columbia Circuit on August 23, 1977, in response to a petition for review: Association of American Railroads (AAR) v. Douglas M. Costle, Administrator of the EPA, (copy of Court Order enclosed).

In the information we have obtained on railroad yard operations, rail car coupling speed can be a factor in the total noise level of the yard. We have information which indicates that at least some rail carriers have established operating rules that couplings should not occur at speeds greater than four miles per hour. This speed of coupling impact being necessary to minimize lading damage for certain commodities being transported by rail.

Pursuant to Public Law 92-574, as amended, we are requesting that you inform us as to whether your firm, as a rail carrier, has at this time in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed. A copy of such rule or recommended practice, if there is one in effect, is requested.

In view of the court order, earlier referenced, with which the Federal Government must comply, your response with the requested information by January 19, 1979, would be appreciated.

Thank you for your prompt attention in this matter. If there are any questions relating to this request Mr. Richard Westlund may be contacted at (703) 557-7666.

Sincerely yours,

Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)

Attachment H-2

ASSOCIATION OF
AMERICAN RAILROADS
LAW DEPARTMENT
AMERICAN RAILROADS BUILDING • WASHINGTON, D. C. 20036 • 202/293-4086

HOLLIS G. DUENSING
General Attorney

January 19, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
U. S. Environmental Protection Agency
Washington, DC 20460

Dear Mr. Thomas:

Thank you for your letter to Mr. Peter Conlon of January 5, 1979, regarding car coupling speed limits. I would like to point out that your letter was not received at AAR until January 15, 1979.

The Association of American Railroads has no rules or standards applying to car coupling speeds.

Discussions with members of the AAR staff on this subject did yield some information on the subject which may be useful. The minimum speed required to assure complete coupling, under free rolling conditions, is about 3 mph. A speed of 4 mph for car coupling has been an operating practice in the railroad industry for several decades, and is primarily related to preventing lading damage of fragile commodities. In reality, however, achieving the optimal speed of 4 mph is difficult. Studies by AAR and freight car builders of car coupling impact speeds show about 50 percent of the events fall into a range of 4.5 to 6.5 mph. About 25 percent of the impacts are above 6.5 mph, and 25 percent are less than 4.5 mph.

The variability in key factors affecting car coupling speeds makes it virtually impossible to maintain consistent car coupling speeds. Human factors play a large role in speed control, as well as mechanical conditions such as rollability of the car, car weight, wheel bearing conditions, track conditions, and foreign substances on wheels and retarders. Tests comparing identical cars under the same conditions find each car reacting differently.

The alternative to free rolling coupling is to "shove to rest"; a term meaning pushing cars together by a locomotive with enough force to close the couplers. To implement this alternative as a noise reduction technique would be totally impractical due to several fundamental reasons. The capacity of a railroad system depends on optimal usage of the facilities, which is based on the maximum number of cars which can be moved in a certain time period. To classify all cars by the shove to rest method would result in an increase in the time required to classify each car by at least an order of magnitude. The net result would be that the classification yards would not be able to handle the present or projected traffic flows.

Thank you for the opportunity to comment on this matter, If we can assist you with any more questions you may have, please let us know.

Sincerely,

Hollis G. Duensing

Hollis G. Duensing

TRAINMEN

Four Miles Per Hour is the standard maximum safe coupling speed. It is a speed equivalent to that of a brisk walk.

Be alert—Pay attention at all times while car movements are being made. Proper switching requires and is worthy of your best attention at all times.

The shipment in the car you are handling may be the one you are waiting for.

It is a fact loaded cars run farther than empties.

Treat EMPTIES the same as LOADS, when switching.

Observe the lading on open top loads. If something does not look right—Report it at once—Do not take chances.

Don't let the car you are riding control you—Controlling it is a part of your job.

The right way is the only way to do a job properly.

Give all signals clearly so that your meaning will be readily understood.

Give your engineman a chance by giving him steady signal before you give him the stop signal.

Failure to give the engineman your full face or full back when giving signals makes it difficult for him to interpret signals. Position yourself so that engineman can see you.

Remember the importance of proper signals. Take a few minutes to study your own signaling. Improper signals contribute much to overspeed impacts.

In flat switching avoid having too many cars in your cut— authorities say not more than 20 cars for best results.

Violent signals are undesirable and unnecessary.

AVOID accidents to man, car or lading.

Keep knuckles open. It's easier on you, the car and the lading.

Don't kick cars when not necessary. Oftentimes a little slack is all that is required to make the cut.

Use the hand brake when necessary to control the speed of cars when engine is not attached. Do not permit car to couple at a speed exceeding 4 M.P.H.

Before shoving a cut of cars, know there is sufficient room on the track to hold the cars and make sure all cars are coupled by taking slack before beginning the shoving movement. Be sure hand brakes are properly set when cars are spotted.

Cars should not be left with close clearance to adjacent tracks creating the hazard of personal injury or property damage. Be sure that car on any track will not foul cars on an adjacent track.

Countless thousands of switches are correctly operated each day but setting a switch in the wrong position or running through a switch has resulted in serious and extensive damage.

Serious damage has resulted from efforts to "drive" stalled cars on ladder tracks.

Do not permit cars to run too fast out of retarders.

Hump riders should ride cars to a coupling. Haste makes waste.

Hand brakes should be tested before cars are cut off at apex of hump.

Report mechanical defects in cars to your conductor or yardmaster so that they can be corrected.

Much damage is caused by leaky air hoses. You can see and hear them—Correct the condition or see that it is corrected.

Comply with your operating rules. They are the result of experience and have been tested many times.

The road-man who brings in a train with the air cut out of some car and fails to say anything about it, is a creator of excessive impacts. The conductors should make report of any cars brought into terminal with air brakes inoperative.

Attachment H-3

The **AKRON, CANTON & YOUNGSTOWN** *Railroad Company*
8 North Jefferson Street
ROANOKE, VIRGINIA 24042

JOHN R. MCMICHAEL
President and Chief Executive Officer

Area Code 703
981-4954

January 17, 1979

A - 270-4

Mr. Henry E. Thomas
Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Please refer to your letter to me of January 3 seeking advice as to AC&Y's rules, operating practices, or recommended practices which relate to locomotive and rail car coupling speed.

AC&Y has adopted the operating Rules of its parent company, Norfolk and Western Railway Company. Hence, the response of Norfolk and Western to this same inquiry is equally applicable to AC&Y. A copy of Mr. Fishwick's letter of January 11 is attached for your easy reference.

Yours very truly,

J. R. McMichael

/rwg

Enc.

NW

January 11, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your letter of January 3 requesting information concerning any Norfolk and Western operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed.

The only written provision among NW's operating Rules which relates to speed of car couplings is the following paragraph from Rule 103(h):

> "When coupling or shoving cars, proper precaution must be taken to prevent damage."

In the course of instructing NW train and engine service personnel, it is our practice to explain this requirement as prohibiting a coupling speed exceeding that of a brisk walk, or approximately four miles per hour.

Sincerely,

(Signed) John P. Fishwick

ALIQUIPPA AND SOUTHERN RAILROAD COMPANY
P.O. BOX 280
ALIQUIPPA, PA. 15001

J. J. DEYAK
GENERAL SUPERINTENDENT

January 17, 1979

Henry E. Thomas, Director
Standards & Regulations
Division (ANR-490)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In response to your request of January 3, 1979, our Rule 52 is quoted below:

> "52. Employes performing switching must do so efficiently and in a manner which will avoid personal injury, damage to contents of cars, equipment, structures or other property.
>
> (a) Before coupling to or moving cars or engines, it must be known that they are properly secured and can be coupled to and moved with safety.
>
> (b) Before coupling to or moving cars on tracks where cars are being loaded or unloaded, gangplanks, conveyors, tank couplings, elevator spouts and similar loading or unloading devices, must be removed and clear for the movement.
>
> (c) Before shoving cars, the cars must be coupled and slack stretched to be sure all couplings are made. Before shoving cars, it must be known there is sufficient room to hold the cars.
>
> (d) Cars must not be shoved out to foul other tracks unless the movement is properly protected.
>
> (e) When switching or placing cars, they must be left where they will fully clear passing cars on adjacent tracks and where they will not cause injury to employes riding on the side of cars.

ALIQUIPPA AND SOUTHERN RAILROAD COMPANY
P.O. BOX 280
ALIQUIPPA, PA. 15001

J. J. DEYAK
GENERAL SUPERINTENDENT

Henry E. Thomas, Director
U. S. Environmental Protection Agency

Page 2
January 17, 1979

(f) Where crews may be working at both ends of a track or a set of associated tracks, the Yardmaster (or Yardmasters) in charge shall assure that the involved crews are properly and timely advised of such situation so as to assure proper protection.

(g) When cars are left on any track, they must be properly secured. When cars are detached from other cars, it must be known that the cars left are properly secured. In setting brakes on cars on a grade, brakes must be set on low end of the cut of cars, and slack must be bunched to know cars will stand when engine is cut off.

(h) When cars are being pulled or shoved by an engine, yardmen shall take such positions as necessary to pass signals to the engine and to assure the safe and proper movement of such cars."

Should you desire anything further, please advise.

Very truly yours,

ALIQUIPPA & SOUTHERN RAILROAD COMPANY

J. J. Deyak
General Superintendent

THE ALTON & SOUTHERN RAILWAY COMPANY

1000 SOUTH 22ND STREET, EAST ST. LOUIS, ILL. 62207
TEL. AREA CODE 618 271-0863

H. D. HUFFMAN
VICE PRESIDENT & GENERAL MANAGER

January 15, 1979
File: A-15-3

Mr. Henry E. Thomas, Director
Standards and Regulations
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your letter of January 3, 1979, received this office January 11, 1979, concerning coupling speeds not to exceed 4 miles per hour.

Our Uniform Code of Operating Rules effective June 2, 1968, Rule 103: "Precautions in Switching" reads in part, "(2) . . . Make couplings at a speed of not more than 4 miles per hour".

Yours very truly,

HDH:vw

National Railroad Passenger Corporation, 400 North Capitol Street, N.W., Washington, D.C. 20001 Telephone (202) 383-3000

Amtrak

January 16, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations
Division (ANR-490)
United States Environmental
Protection Agency
Washington, DC 20460

Dear Mr. Thomas:

Your letter of January 3 to Mr. Boyd has been forwarded to me for handling.

Amtrak operates under contract with various carriers to provide switching throughout the country. Under these contracts, the railroads operate under their own Book of Rules, which prescribe coupling speeds. On the Northeast Corridor, Amtrak currently operates under Rule 130 of the Penn Central Rules for Conducting Transportation (copy enclosed) which stipulates:

> "Engines and cars must be coupled at a speed not to exceed 4 mph."

This rule is a common one. In our own rule book which will take effect April 30, 1979, the coupling speed is also 4 mph, per Rule Number 130 (copy enclosed).

If there are any further questions, please contact my office.

Sincerely,

R A Herman

Robert A. Herman
Vice President - Operations

Enclosures

A passenger train routed to a track which will result in a station stop for receiving or discharging traffic across a track between that train and the station platform must stop and obtain assurance from the Train Dispatcher or Operator that other trains involved have been advised of the situation and given instructions. When assurance has been previously furnished in writing or by radio, the stop need not be made.

When a regular train running on its assigned track must discharge and receive passengers across a track between that train and the station platform, protection against other trains is not required when the train is running on schedule. When such a train is running behind its schedule, the Train Dispatcher must provide protection against all other involved trains.

110. On secondary tracks where Block Signal System rules are not in effect, trains and engines may proceed at Reduced Speed after receiving signal indication, permission of employe in charge, or in an emergency under flag protection. When movement has been completed, it must be reported clear except when clearing at an interlocking or block station. Trains and engines will not protect against following movements unless specified in the Timetable.

111. Unless otherwise specified in the Timetable, trains and engines using a siding may proceed at Restricted Speed and will not protect against following movements.

A siding of an assigned direction must not be used in the reverse direction without proper signal indication, authority of the employe in charge, or in an emergency under flag protection.

Trains or engines using a controlled siding will operate in accordance with signal indications.

112. On a running track, movements may proceed at Restricted Speed after receiving signal indication, permission of employe in charge, or as specified in the Timetable and in an emergency under flag protection. When movement has been completed, it must be reported clear except when clearing at an interlocking or block station. Protection against following movements will not be provided unless specified in the Timetable.

113. Movements on tracks other than main, secondary, running tracks, and sidings may proceed at Restricted Speed unless otherwise specified in the Timetable.

130. Engines and cars must be coupled at a speed not to exceed 4 miles per hour.

not protect against following movements unless specified in the timetable.

111. Unless otherwise specified in the timetable, trains and engines using a siding may proceed at Restricted Speed and will not protect against following movements.

A siding of an assigned direction must not be used in the reverse direction without proper signal indication authority of the employe in charge, or in an emergency under flag protection.

Trains or engines using a controlled siding will operate in accordance with signal indications.

112. On a running track, movements may proceed at Restricted Speed, on signal indication, permission of employe in charge or as specified in the timetable and in an emergency under flag protection. When movement has been completed it must be reported clear; except, when clearing at an interlocking, block station or where switch tenders are on duty. Protection against following movements will not be provided unless specified in the timetable.

113. Movements on tracks other than main, secondary, running tracks and sidings may proceed at Restricted Speed unless otherwise specified in the timetable.

130. Engines and cars must be coupled at a speed not to exceed 4 miles per hour.

130a. A stop must be made just prior to coupling occupied passenger equipment. Cars occupied by passengers and cars placed on tracks occupied by such cars must be handled with air brakes in service.

130b. Cars placed for loading or unloading, must not be coupled to nor moved until all persons in or about them have been notified and all obstructions under or about the cars, transfer boards, and attachments have been removed. When such cars are moved they must be returned to original location.

Sign reading "Stop-Tank Car Connected," indicates tank cars are connected for loading or unloading and must not be coupled to or moved. Cars must not be placed on the same track that may obstruct the view of a sign without first notifying the person in charge.

BANGOR AND AROOSTOOK RAILROAD COMPANY
Northern Maine Junction Park RR 2 Bangor, Maine 04401 (207) 848-5711

February 9, 1979

Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

At the request of Mr. Travis, I am enclosing a copy of a portion of our Operating Rules relative to switching cars. You will note that the rule in question requires that a speed limit of two miles per hour be imposed when coupling cars.

Very truly yours,

Wm. M. Houston

William M. Houston
Vice President and
General Counsel

Enclosure

WMH/p

cc: Walter E. Travis

THE BELT RAILWAY COMPANY OF CHICAGO

6900 SOUTH CENTRAL AVENUE • CHICAGO, ILLINOIS 60638

RICHARD F. KOPROSKE
GENERAL COUNSEL

312-496-4040

January 31, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Pursuant to your request for whatever rules we may have concerning operating practices relating to locomotive and rail car coupling speed, please find attached a copy of the appropriate sections of The Belt Railway Company's special instructions.

Sincerely,

Richard F Koproske

RFK:jms
encl.

cc: H. G. Duensing, Gen. Attny.
Law Department
Association of Amer. Railroads
American Railroad Building
1920 L Street N.W.
Washington, D. C. 20036

43. AVOID DAMAGE – SWITCH CUSTOMERS CARS CAREFULLY

JUDGING SPEED

Accurate judgment of coupling speed depends upon correct timing. An excellent way to get accurate timing without a watch is to count "one hundred and thirty-one, one hundred and thirty-two" and so on as the car passes a stationary point. With a little practice counting can be done at the rate of one a second. Try it.

Ability to closely estimate speed at time car strikes is extremely important because the resultant destructive effect builds up in direct ratio to the square of the speed. This means that impact delivered by a car coupled at 8 M.P.H. is not four times that at 2 M.P.H. but 16 TIMES AS GREAT. Damage to freight and car can be avoided by always keeping coupling speed within the safe range of – NOT OVER 4 MILES PER HOUR – about the speed of a BRISK WALK.

Impact force at various striking speeds:

Car Coupled at		Units of Destructive Force
1 MPH	SAFE	1
2 MPH		4
3 MPH		9
4 MPH		16
5 MPH	DAMAGING	25
6 MPH		36
7 MPH		49
8 MPH		64
9 MPH		81
10 MPH		100

44. SPEED GUIDE – To find coupling speed of 40 foot and 50 foot car.

Sight vertical end of car body on a fixed point and note the number of seconds it takes car to pass. Speed in miles per hour is shown below.

Damage as a result of Rough Handling makes up a large part of the claim bill for Loss and Damage to Freight. From the Railroad standpoint it is the major item in the expense. We all know that Rough Handling can be reduced, often eliminated. It is hoped that this guide will be helpful in your efforts to prevent Rough Handling.

Switch crews must function as a team. Clear signals properly given are mighty important:

Talk it over – prevent Rough Handling – it can be done.

Seconds		40 foot car (Miles per Hour)		50 foot car (Miles Per Hour)
1		28		35
2		14		17.5
3		9.3		11.6
4		7		8.7
5		5.6		7
6		4.7		5.9
7	SAFE COUPLING SPEED	4		5
8		3.5		4.4
9		3.1	SAFE COUPLING SPEED	3.9
10		2.8		3.5
11		2.5		3.1
12		2.3		2.9
13		2.15		2.7
14		2		2.5

Car retarder operators are responsible to use the necessary judgment essential to maintain continuous hump operation classification, proper position of switches, before a car is permitted to enter retarders, set up car retarders to the position required to properly retard and control the speed of cars that will permit the required coupling or required entrance to mechanical car stopper not to exceed a 4 mile per hour speed.

BESSEMER AND LAKE ERIE RAILROAD COMPANY
600 GRANT STREET • P. O. BOX 536 • PITTSBURGH, PENNSYLVANIA 15230

M. SPALDING TOON
PRESIDENT

January 15, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This is in response to your letter of January 3 requesting information relating to locomotive and rail car couplings.

Industrial switching is placing cars for loading and unloading at various industries. Couplings are made at slow speeds with the engine attached and at speeds of no more than three to four miles per hour.

Classification yard switching is usually for line haul movement and consists of a series of tracks with each one designated for a different destination. Cars are allowed to move onto these tracks detached from the locomotive and couple to other cars already on the tracks at speeds averaging five to six miles per hour. Empty cars are even permitted to couple to other cars at speeds up to seven and eight miles per hour and do so without damage.

We do not have an operating rule specifying coupling speeds, but as a matter of practice, the speeds under these two types of switching are as stated above.

Yours very truly,

President

BIRMINGHAM SOUTHERN RAILROAD COMPANY

POST OFFICE BOX 579
FAIRFIELD, ALABAMA 35064

JOHN L. PARKER
GENERAL SUPERINTENDENT

March 19, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In response to your letter of January 3, 1979, regarding rail car coupling speeds, please be advised that the Birmingham Southern Railroad Company does not have in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speeds.

Sincerely,

John L Parker

John L. Parker

JLP:ems

BOSTON AND MAINE CORPORATION, DEBTOR
IRON HORSE PARK
NORTH BILLERICA, MASSACHUSETTS 01862
617/667-6100

ROBERT W. MESERVE
BENJAMIN H. LACY
TRUSTEES

ALAN G. DUSTIN
PRESIDENT AND CHIEF EXECUTIVE OFFICER

January 16, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division
U.S. Environental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

In reference to your letter of January 3, 1979.

The Boston and Maine has issued verbal operating instructions to its employees that cars should not be coupled at a speed greater than 4 mph. The instructions have not been embodied in any operating rule or written procedure.

Sincerely,

A G Dustin

BURLINGTON NORTHERN

JOHN H. HERTOG
Senior Vice President – Operations

176 East Fifth Street
St. Paul, Minnesota 55101

Mr. Henry E. Thomas, Director
Standards & Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

March 27, 1979

Dear Mr. Thomas:

Please refer to your letter dated March 16 addressed to Mr. J. D. Giallombardo, with which you forwarded a copy of your letter dated January 3 to Mr. Muelder requesting car coupling information.

Burlington Northern Inc. has no formal operating rule or written practice regarding coupling speed. As a recommended practice, Burlington Northern does follow the AAR recommendation of four miles per hour coupling speed in order to minimize damage to equipment and lading. A chart of the coupling speed and resulting impact forces are on the back page of all our timetables. A copy of the page is enclosed for your information.

Sincerely,

J. H. Hertog

Attachment

File 40-18 Noise

THE COLORADO AND SOUTHERN RAILWAY COMPANY
A SUBSIDIARY OF BURLINGTON NORTHERN
2000 EXECUTIVE TOWER/1405 CURTIS STREET/DENVER, COLORADO 80202

BURLINGTON
NORTHERN

GEORGE F. DEFIEL
President

January 16, 1979
AAR-Research

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Reference is made to your January 3, 1979 letter concerning railroad noise emission standards and request for information as to locomotive and rail car coupling speed.

The Colorado and Southern Railway Company's current Timetable and Special Instructions dated October 31, 1976 provides on page 16, copy attached, that switching will be performed in a manner which will avoid damage to contents of cars and equipment and the maximum safe coupling speed is 4 MPH.

Yours very truly,

G F Defiel

G. F. Defiel

Attch.

PERFORM SWITCHING IN A MANNER WHICH WILL AVOID DAMAGE TO CONTENTS OF CARS AND EQUIPMENT

Safe Coupling Speed (MPH)	Impact Force
1	1
2	4
3	9
4	16
Damaging Coupling Speed (MPH)	**Damaging Force**
5	25
6	36
7	49
8	64
9	81
10	100

SPEED TABLE

Time Per Mile Minutes	Time Per Mile Second	Miles Per Hour	Time Per Mile Minutes	Time Per Mile Second	Miles Per Hour
1	12	50	2	40	22.5
1	15	48	2	45	21.8
1	20	45	2	50	21.2
1	25	42.3	3	....	20
1	30	40	3	9	19
1	40	36	3	20	18
1	45	34.3	3	31	17
1	50	32.7	3	45	16
2	....	30	4	....	15
2	10	27.6	5	....	12
2	15	26.6	6	....	10
2	20	25.7	7	30	8
2	30	24	10	....	6

FORT WORTH AND DENVER RAILWAY COMPANY
A SUBSIDIARY OF BURLINGTON NORTHERN
FORT WORTH CLUB BUILDING, POST OFFICE BOX 943, FORT WORTH, TEXAS 76101

**BURLINGTON
NORTHERN**

GEORGE F. DEFIEL
President

Mr. Henry E. Thomas
Director, Standards and
Regulations Division
(ANR-490)
United States Environmental
Protection Agency
Washington, D.C. 20460

January 16, 1979

Dear Mr. Thomas:

Please refer to your letter of January 3, 1979 requesting information and documents pertinent to operating rules or practices governing locomotive and rail car coupling speeds.

FW&D Timetable and Special Instructions is attached and your attention is directed to page 16. Also attached is photo-copy of Rules 808 and 810 of "The Consolidated Code of Operating Rules." I trust these documents will furnish the information you desired.

Yours truly,

G F Defiel

G. F. Defiel

cc: Mr. W. L. Peck

File: 6700-3A1

able, boom must be trailing. Such equipment must be inspected before being moved.

Spreaders and dozers being moved in trains must, when practicable, be headed in the direction train is moving, wings must be properly secured.

The conductor and engineer must be notified when such equipment is in their train.

805 (E). Open-top or flat cars loaded with pipe, lumber, poles or other lading which has a tendency to shift, must not be handled in train next to engine, caboose, occupied outfit cars or passenger cars.

806. Before coupling to or moving outfit cars, notice must first be given all occupants, and all ladders and other equipment cleared before moving.

When occupied outfit cars are set out or taken into yards in trains, the train dispatcher and the yardmaster must be promptly notified. When practicable, occupied outfit cars should not be placed adjacent to or in buildings or structures.

Tracks upon which occupied outfit cars are located should not be used for meeting or passing trains if it can be avoided.

807. Except in emergency, cars must not be left on sidings without authority. The train dispatcher must be immediately notified when cars are left on sidings.

808. Employes performing switching must do so efficiently and in a manner which will avoid personal injury, damage to contents of cars, equipment, structures or other property.

tached from other cars it must be known that the cars left are properly secured. If the track is on a grade and hand brakes are not sufficient, wheels must also be blocked or chained and, when practicable, cars must be coupled together. In setting brakes on cars on a grade, brakes must be set on low end of the cut of cars and slack must be bunched to know cars will stand when engine is cut off.

810. The following equipment must not be unnecessarily switched with nor couplings made in such a manner as may cause damage to equipment or load:

- Flexivan or TOFC cars;
- Outfit cars;
- Passenger equipment;
- Cabooses;
- Multi-level loads;
- Cars containing livestock;
- Open top loads subject to shifting.

811. Before making a running switch, all members of the crew must understand the movement to be made. It must be known that switches and brakes are in working order. The engine must be run on straight track when practicable.

Running switches must not be made under the following conditions:

- With cars containing explosive, flammables or poison gas;
- Over or through spring switches or within interlocking limits;
- Over or through remote control or dual control switches when the power is on.

PERFORM SWITCHING IN A MANNER WHICH WILL AVOID DAMAGE TO CONTENTS OF CARS AND EQUIPMENT

Safe Coupling Speed (MPH)	Impact Force
1	1
2	4
3	9
4	16
Damaging Coupling Speed (MPH)	**Damaging Force**
5	25
6	36
7	49
8	64
9	81
10	100

MAINTENANCE OF WAY CONDITIONAL STOP

Form Y Train Order

The following forms of oral authorization by the Foreman and acknowledgment of understanding by the engineer are to be used to permit trains to pass a red flag without stopping within the limits of a Form Y train order.

Foreman will state: "FW&D Railway Foreman calling Extra 232 East about Order No. (Form Y Train Order No.)"

Engineer must respond, identifying his train as: "This is FW&D engineer, Extra 232 East."

When engineer has answered as above, the foreman will state: "Extra 232 East may pass red signal at (Location) without stopping."

The foreman may also authorize a different speed from that shown in the Form Y train order by adding to his instructions: "Proceed at ________ MPH," or "Proceed at normal speed."

The engineer must repeat back to the foreman the instructions that are given him.

SPEED TABLE

Time Per Mile		Miles Per Hour	Time Per Mile		Miles Per Hour
Minutes	Seconds		Minutes	Seconds	
1	12	50	2	40	22.5
1	15	48	2	45	21.8
1	20	45	2	50	21.2
1	25	42.3	3	—	20
1	30	40	3	9	19
1	40	36	3	20	18
1	45	34.3	3	31	17
1	50	32.7	3	45	16
2	—	30	4	—	15
2	10	27.6	5	—	12
2	15	26.6	6	—	10
2	20	25.7	7	30	8
2	30	24	10	—	6

COMPANY D

Dr. W. P. Higgins, Jr., Chi
Dr. James P. Lee, Division S

Abilene
Amarillo
Anson
Bowie
Childress
Clarendon
Dalhart
Decatur
Dimmitt
Electra
Fort Worth
Fort Worth
Henrietta
Houston
Iowa Park
Lockney
Lubbock ________ Dr.
Memphis
Memphis
Memphis
Munday
Plainview
Quanah
Stamford
Vernon
Wellington
Wichita Falls

JOHN C. ASHTON
Vice President and Secretary

178 East Fifth Street
St. Paul, Minnesota 55101
(612) 298-3250

Mr. Henry E. Thomas, Director
Standards and Regulations Divisions
United States Environmental Protection Agency
Washington, D.C. 20460

January 17, 1979

Dear Mr. Thomas:

Please refer to your letter dated January 3, 1979, in connection with freight car coupling speed restrictions.

Burlington Northern practices govern train operations on the Oregon Electric.

BN has recommended safe coupling speeds, not to exceed 4 mph. These recommendations are published on the back page of all time tables. Copy of the front and back pages of Seattle Region Time Table 16 is enclosed as an example of the coupling speed requirements which are meant to govern operations over the Oregon Electric.

Yours very truly,

John C. Ashton

President, Oregon Electric Railway Company

Attachment

PERFORM SWITCHING IN A MANNER WHICH WILL AVOID DAMAGE TO CONTENTS OF CARS AND EQUIPMENT

Safe Coupling Speed (MPH)	Impact Force
1	1
2	4
3	9
4	16
Damaging Coupling Speed (MPH)	**Damaging Force**
5	25
6	36
7	49
8	64
9	81
10	100

SPEED TABLE

Time Per Mile tes	Time Per Mile Seconds	Miles Per Hour	Time Per Mile Minutes	Time Per Mile Seconds	Miles Per Hour
	45	80	1	12	50
	46	78.3	1	15	48
	47	76.6	1	20	45
	48	75	1	25	42.3
	49	73.5	1	30	40
	50	72	1	40	36
	51	70.6	1	45	34.3
	52	69.2	1	50	32.7
	53	67.9	2	....	30
	54	66.6	2	10	27.6
	55	65.4	2	15	26.6
	56	64.2	2	20	25.7
	57	63.1	2	30	24
	58	62.0	2	40	22.5
	59	61.0	2	45	21.8
	....	60	2	50	21.2
	1	59	3	....	20
	2	58	3	9	19
	3	57.1	3	20	18
	4	56.2	3	31	17
	5	55.3	3	45	16
	6	54.5	4	....	15
	7	53.7	5	....	12
	8	52.9	6	....	10
	9	52.1	7	30	8
	10	51.4	10	....	6

MAINTENANCE OF WAY CONDITIONAL STOP

(Form Y Train Order)

The following forms of oral authorization by the Foreman and acknowledgment of understanding by the engineer are to be used to permit trains to pass a red flag without stopping within the limits of a Form Y train order.

Foreman will state: "Burlington Northern Railway Foreman calling Extra 232 East about Order No. (Form Y Train Order No.)"

Engineer must respond, identifying his train as: "This is Burlington Northern engineer, Extra 232 East."

When engineer has answered as above, the foreman will state: "Extra 232 East may pass red signal at (Mile Post Location and specify Track involved) without stopping."

The foreman may also authorize a different speed from that shown in the Form Y train order by adding to his instructions: "Proceed at ______________ MPH," or "Proceed at normal speed."

The engineer must repeat back to the foreman the instructions that are given him.

Central Vermont Railway, Inc.
2 Federal Street
St. Albans, Vt., 05478

January 12, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In reply to your letter of January 3, 1979 requesting a copy of our instructions relating to rail car coupling speed, we are pleased to be of assistance and have enclosed a copy of our General Operating Instructions which have been in effect on the Central Vermont Railway, Inc. for a number of years.

Sincerely Yours,

P. C. Larson
General Manager

Enc.

CENTRAL VERMONT RAILWAY, INC.
GENERAL INSTRUCTIONS

1.20 COUPLING REGULATIONS

(A) When coupling cars, speed of four miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading. This applies to all cars including those with cushioned underframes.

(B) Before making a coupling to occupied passenger equipment, stop must first be made not less than six, and not more than twelve feet from the point where coupling is to be made.

(C) Before making a coupling to occupied service equipment, persons in or about these cars must be warned, stop must first be made not less than six, and not more than twelve feet from the point where coupling is to be made.

(D) When coupling an engine consist of three or more units, with or without cars to a train or cut of cars, a stop must first be made not less than six, and not more than twelve feet from point where coupling is to be made.

(E) Before coupling is made with or onto cars equipped with cushion underframes and/or long shank type couplers, the drawbars must be checked to ensure that they are properly lined up. Wherever possible, this type of car should be left on straight track for coupling. If not possible, extreme caution must be used when coupling.

(F) Before coupling to or moving passenger and service equipment cars, crews must

Operating Department

Chessie System

2 North Charles Street
Baltimore, Maryland 21201

January 17, 1979
File: 741-3

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This is in response to your letters of January 3, 1979, regarding "operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed," to the following Chessie System Officers:

H. T. Watkins - Chessie System
J. T. Collinson - Baltimore and Ohio Railroad Company
J. T. Collinson - Chesapeake and Ohio Railway Company
J. T. Collinson - Lake Front Dock and Railroad Terminal
W. P. Coliton - Western Maryland Railway Company

As a member of the Association of American Railroad (A.A.R.) Chessie System subscribes to the carrier loading rules developed and published by the Operations and Maintenance Department of the A.A.R. These rules require that shipper blocking and bracing proposals be subjected to impact tests, as well as field tests, prior to rail industry acceptance. The impact test calls for satisfactorily subjecting the test shipment to a series of 4, 6, 8 and reverse 8 MPH impacts.

Chessie recognizes that the objectives of car handling standards and loading rules are to minimize damage and that shippers, like carriers, are not always consistent in meeting optimum levels of performance in every shipment transported. While we strive to keep impacts within the 0 to 4 MPH range as acceptable for desired handling, we recognize that factors other than human element influence the speed at which a car couples, such as track gradient, equipment condition, hump retardation techniques, weather conditions, and the occasional failure to any of the previously mentioned subjects. We attempt to define these factors, use good judgment and provide educational assistance to crews through an aggressive careful car handling program. Chessie's program is just one of many in the rail industry and includes a measurement system that quantifies impacts of 5 MPH or more.

We agree with your statement that railroad yard operations and rail car coupling speed can be a factor in the total noise level of a yard. However, there are many variables that also bear some relationship to the noise generated during switching operations. Some are:

- A. Loaded car versus empty car.
- B. Type of car.
- C. Type of coupler.
- D. Car coupling to solid cut.
- E. Car coupling to another free standing car.
- F. Geography surrounding yard.
- G. Lading in car.
- H. Weight of car and lading.
- I. Number of cars on adjacent tracks.
- J. Human factor (Judgment).

Every switching move, coupling, uncoupling and doubling up trains for dispatchment hinges on judgment, by crew members individually and collectively numerous times per hour and hundreds of times per tour of duty with 10 to 20 crews per hour in more congested areas working within or into or out of a yard area. There is no alternative to our present technique, based on the present technology, without crippling effects to the rail industry.

As stated above, for a variety of reasons, not all cars are consistently coupled within the same range of speed. Since it is impractical because of the influence of other variables on the amount of noise generated by an individual coupling(s), we feel that it is not realistic to establish a coupling speed standard as a control of yard noise levels.

Yours very truly,

RG Rayburn

R. G. Rayburn
Vice President-Transportation

Operating Department

Chessie System

2 North Charles Street
Baltimore, Maryland 21201

January 23, 1979
File: 741-3

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This is in response to your letter of January 3, 1979, to Mr. B. G. Lawler, Assistant Vice President, Baltimore and Chicago Terminal Railroad Company, regarding "operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed."

My letter of January 17, 1979, covered similar letters to other officers on the Chessie System. That letter would also apply to operations on the Baltimore and Ohio Chicago Terminal Railroad Company.

Yours very truly,

R G Rayburn

R. G. Rayburn
Vice President-Transportation

CHICAGO & ILLINOIS MIDLAND RAILWAY COMPANY

POST OFFICE BOX 139
SPRINGFIELD, ILLINOIS 62705

January 11, 1979

Mr. Henry E. Thomas, Director,
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency,
Washington, D. C. 20460

Dear Sir:

Reference is made to your letter of January 3 requesting information as to whether or not we have in effect an operating rule relative to locomotive and rail car coupling speed.

Enclosed is a copy of our Stations and Special Instructions for government of our employees in which you will note on pages 27 and 28 that we do have a recommended coupling speed of 4 miles per hour.

Yours truly,

W. G. Harvey

W. G. Harvey,
Executive Vice President
and General Manager.

WGH:K
Encl.

CHICAGO AND NORTH WESTERN TRANSPORTATION COMPANY

JAMES A. ZITO
VICE PRESIDENT - OPERATIONS

February 26, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your letter of February 20 addressed to Mr. J. R. Wolfe on the subject of "Coupling Speed" has been referred to me.

We do not have an operating rule that specifically states the maximum speed for coupling cars. Our Consolidated Code of Operating Rule 808 reads as follows:

> 808. Employes performing switching must do so efficiently and in a manner which will avoid personal injury, damage to contents of cars, equipment, structures or other property.

While we do not specify that couplings should not occur at speeds greater than 4 MPH due to the varied physical characteristics of our many yards, we recognize that this is the ideal coupling speed and this speed is our goal wherever conditions permit.

Since the year 1971 we have had a "Car Handling Program" to eliminate the rough handling of cars and loss and damage to freight; our yard forces are taught and instructed to use minimum coupling speeds. This is enforced by both Freight Damage Prevention and Division Officers by the use of "radar". Violations are handled in the same manner as any other rules violation.

This program has resulted in 84% of all coupling speeds made at 4 MPH or less systemwide. We have also spent large sums correcting the grades in yards on the Iowa and Lake Shore Divisions so that it was practicable to enforce our stated goal of 4 MPH or less speed in coupling cars.

Very truly yours,

J. A. Zito

**Chicago, Milwaukee, St. Paul
and Pacific Railroad Company**

516 West Jackson Boulevard
Chicago, Illinois 60606
Phone 312/648-3000

January 18, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your letter of January 3, 1979 to Mr. B. J. Worley, Chicago, Milwaukee, St. Paul & Pacific Railroad Company, requesting information on coupling speeds has been referred to me.

This carrier does not have an operating rule indicating a specific coupling speed. Our trainmen and enginemen performing switching must do so efficiently and in a manner which will avoid personal injury, damage to contents of cars, equipment, structures or other property.

WFPlattenberger

W. F. Plattenberger
AVP - General Manager

cc: Messrs. B. J. Worley
G. J. Barry

CHICAGO UNION STATION COMPANY

210 SOUTH CANAL STREET
CHICAGO, ILLINOIS 60606
FINANCIAL 6-3200

WILLIAM M. FREUND
GENERAL MANAGER

January 11, 1979

Mr. Henry E. Thomas, Director
Standards & Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Please refer to your letter of January 3, 1979 to Mr. N. H. Goodrich, asking if the Chicago Union Station Company has in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed.

The Chicago Union Station Company does not have a specific rule governing coupling speed.

Yours very truly,

W. M. Freund

WMF/mb

CLINCHFIELD RAILROAD COMPANY
229 Nolichucky Avenue

THOMAS D. MOORE, JR.
Executive Vice President -
General Manager

ERWIN, TENNESSEE 37650

January 11, 1979

File: 995-1

Mr. Henry E. Thomas, Director,
Standards and Regulations,
Division (ANR-490),
United States Environmental Protection Agency,
Washington, D. C. 20460.

Dear Mr. Thomas:

In response to yours of January 3, 1979, relative to four miles per hour coupling requirement, I attach copy of our current Operating Rule Book effective September 15, 1955, and current Time Table No. 32 effective February 16, 1975.

You will note Rule 103 (d) on Page 38 of the Rule Book and the inside front cover of the Time Table contain our rule and policy regarding coupling speed.

Sincerely yours,

T. D. Moore, Jr.
Executive Vice President
General Manager

a trainman must afford protection at crossings opened until such crossings are closed.

103 (c). When necessary to control cars by hand brakes, it must be ascertained that such brakes are in good order.

When cars are left standing, sufficient hand brakes must be applied to keep them from moving, or other precautions taken, if necessary, to assure that they are properly secured.

Cars left standing on any track must clear other tracks, insulated joints and clearance points. Road crossings must be cleared 100 feet where practicable.

103 (d). When coupling or switching cars, or when cars are cut off in motion, coupling speeds must be held within safe limits (not to exceed four miles per hour if possible) and proper precautions taken to prevent damage or fouling other tracks. When engines are working at both ends of a track, movement must be made carefully to avoid injuries or damage. Before shoving slack must be stretched to insure that cars are coupled.

104. Conductors are responsible for the position of switches used by them and their trainmen, except where switch tenders are stationed. Switches must be properly lined after having been used.

A switch must not be left open for a following train or engine unless in charge of a trainman of such train or engine.

When practicable, the engineman must see that the switches near the engine are properly lined.

Employes lining switches must see that the points fit properly and that switch targets are in the proper position.

A train or engine must not foul a track until switches connected with the movement are properly lined, or in the case of spring switches, until the normal route is seen to be clear. When waiting to cross from one track to another and during the approach or passage of a train or engine on tracks involved, all switches connected with the movement must be secured in normal position. Switches must not be restored to normal position until the movement is completed or clear of the main track involved.

Where trains or engines are required to report clear of main track, such report must not be made until switch has been secured in its normal position.

Reproduced from
best available copy.

NOTE—Rule 104 applies only to hand operated switches. When spring or dual control switches are operated by hand, they are construed to be hand operated switches and rule 104 applies.

104 (a). After an employe changes a switch to let a train or engine into or out of a track, he must take a position not less than 20 feet from the switch. Employes must not stand in such a position as to obscure the view of switches or signals as seen from an approaching train or engine.

No attempt must be made to change a switch until the last wheels are clear of the points.

104 (b). A switch found damaged or defective must be securely spiked in proper position, notice given to the section foreman and a report made at once to the Chief Dispatcher.

Every main track switch in normal position must be locked. Employes locking the switches must check the lock and know that it is secured. After opening switch equipped with lock the lock must be placed in the hasp. Switch locks found defective or missing must be replaced promptly if practicable, a report made to the chief dispatcher and the section foreman notified if possible.

104 (c). Derails must be set to derail and locked in that position, except when lined to permit movements. Employes must be on the look out for derails on all side tracks, except passing sidings.

104 (d). A hand thrown switch, pipe-connected with derail, must not be restored to normal position until the movement has cleared the derail.

104 (e). When a train backs in on a siding to be met or passed by another train and is in the clear the engineman must see that the switch is set for the main track. Enginemen must know that derails and other switches are properly set before using them.

104 (f). When a trailing movement through a spring switch is stopped before passing entirely through the switch, the movement must not be reversed, nor slack taken, until it has been ascertained that the switch is properly set.

104 (g). Running switches are prohibited except when they can be made without danger to employes, equipment, or contents of cars. It must be known that the track is clear and the

1275 Daly Avenue
Bethlehem, Pennsylvania 18015

January 19, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In reply to your letters of January 3, 1979, relating to car coupling speed in railroad yard operations, all the railroads listed below are small terminal and switching railroads. They do not have any humping operations and flat switching with rolling couplings is held to an absolute minimum because there are no large classification yards. Most switching to assemble cars is performed at local points involving small numbers of cars rather than in concentrated yard areas. For these reasons the railroads do not have written operating rules or recommended practices relating to locomotive and rail car coupling speed. Their operating practices, however, are such that all railroad movements are made at moderate speeds seldom exceeding that of a walking pace and the speed of coupling impact is considerably less than that so as to minimize, really to eliminate, car and lading damage.

Very truly yours,

CONEMAUGH & BLACK LICK RAILROAD COMPANY
PATAPSCO & BACK RIVERS RAILROAD COMPANY
PHILADELPHIA, BETHLEHEM AND NEW ENGLAND
RAILROAD COMPANY
SOUTH BUFFALO RAILWAY COMPANY

T H Semmel
T. H. Semmel
President

CONRAIL

RICHARD B. HASSELMAN
SENIOR VICE PRESIDENT
OPERATIONS

January 12, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division
U.S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your January 3 letter to former President Spence inquiring whether Conrail has an operating rule or practice relating to coupling speeds.

This subject is covered in Rule 130 in our present Book of Rules. Copy of the applicable page is attached.

Sincerely,

RBHasselman

not protect against following movements unless specified in the timetable.

111. Unless otherwise specified in the timetable, trains and engines using a siding may proceed at Restricted Speed and will not protect against following movements.

A siding of an assigned direction must not be used in the reverse direction without proper signal indication, authority of the employe in charge, or in an emergency under flag protection.

Trains or engines using a controlled siding will operate in accordance with signal indications.

112. On a running track, movements may proceed at Restricted Speed, on signal indication, permission of employe in charge or as specified in the timetable and in an emergency under flag protection. When movement has been completed it must be reported clear; except, when clearing at an interlocking, block station or where switch tenders are on duty. Protection against following movements will not be provided unless specified in the timetable.

113. Movements on tracks other than main, secondary, running tracks and sidings may proceed at Restricted Speed unless otherwise specified in the timetable.

130. Engines and cars must be coupled at a speed, not to exceed 4 miles per hour.

130a. A stop must be made just prior to coupling occupied passenger equipment. Cars occupied by passengers and cars placed on tracks occupied by such cars must be handled with air brakes in service.

130b. Cars placed for loading or unloading, must not be coupled to nor moved until all persons in or about them have been notified and all obstructions under or about the cars, transfer boards, and attachments have been removed. When such cars are moved they must be returned to original location.

Sign reading "Stop-Tank Car Connected," indicates tank cars are connected for loading or unloading and must not be coupled to or moved. Cars must not be placed on the same track that may obstruct the view of a sign without first notifying the person in charge.

Reproduced from
best available copy.

Windsor Station, Montreal, Quebec H3C 3E4
Tel (514) 861-6811

CP Rail

January 11, 1979

File No. 59-1-00

Mr. Henry E. Thomas,
Director,
Standards and Regulations
Division (ANR-490),
United States Environmental
Protection Agency,
Washington, D.C. 20460
U.S.A.

Dear Mr. Thomas:

In reply to your letter of January 3 requesting copy of any instructions in effect on CP Rail dealing with coupling speeds.

The following instruction contained in Form CS 44 is included for the guidance of employees:

"When coupling cars together, speed of four miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading. After coupling, it must be known that locking blocks and pins of the coupler have dropped into place. Slack must be taken or seen to run out to ensure a proper coupling has been made."

Yours truly,

Deputy Chief Engineer.

THE CUYAHOGA VALLEY RAILWAY COMPANY
815 CLARK AVENUE
P. O. BOX 6073
CLEVELAND, OHIO 44101

R. B. SHAFER
GENERAL SUPERINTENDENT

January 30, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Please refer to your Certified letter of January 3, 1979 wherein you requested information about certain operating practices.

The Cuyahoga Valley Railway Company is a Class II railroad, located in the confines of Jones and Laughlin Steel Corporation in Cleveland, Ohio. We own 13.71 miles of track and are registered with the Federal Railroad Administration as having Class I track.

Our railroad is located on the banks of the Cuyahoga River and is a flat, yard switching operation with a published maximum speed not to exceed ten miles per hour.

The rule in our operating rule book which specifically refers to coupling speed is under the Engineers' Section - Rule #223 (f) which states, "He must exercise caution and good judgment in starting and stopping and in moving and coupling equipment, so as to avoid injury to persons or damage to property."

Very truly yours,

THE CUYAHOGA VALLEY RAILWAY COMPANY

R. B. Shafer

R. B. SHAFER
GENERAL SUPERINTENDENT

RBS/1

DELAWARE AND HUDSON RAILWAY COMPANY
ALBANY, NEW YORK 12207

Dependable Transportation Since 1823

KENT P. SHOEMAKER
President and Chief Executive Officer

January 17, 1979
369

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental
Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Reference your letter of January 3, 1979 regarding railroad noise emission standards and, in particular, the speed of coupling impact.

Over the past years we have circularized the use of the four (4) miles per hour maximum coupling speed in connection with our loss and damage prevention programs.. However, we do not have in effect at this time an operating rule, operating practice or recommended practice relating to coupling speed.

Very truly yours,

Rio Grande
THE DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY
P. O. BOX 5482
DENVER, COLORADO 80217
ROY S. ENO
DIRECTOR
SAFETY, RULES & TRAINING

JOHN J. VESS
SUPT. SAFETY, RULES & TRAINING
COLO. DIVN. – DENVER, COLO.

JOHN E. ABERTON
SUPT. SAFETY, RULES & TRAINING
UTAH DIVN. – ROPER, UTAH

January 17, 1979

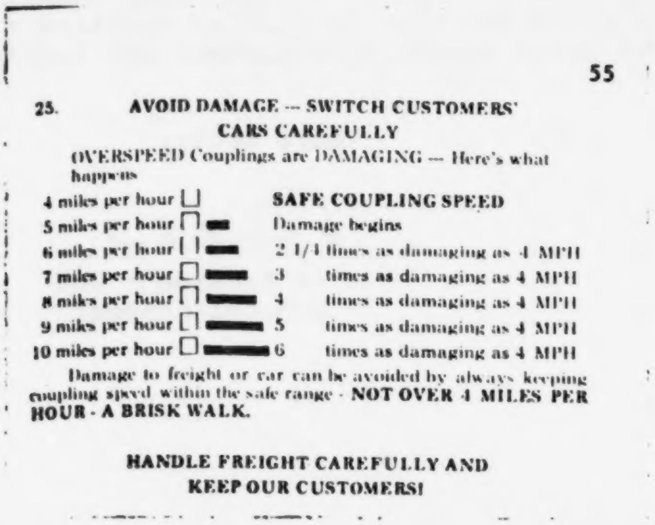
Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. - 20460

Dear Mr. Thomas:

Mr. E. P. Herrick, our Environmental Engineer, referred your letter of Jan. 3, 1979 to me for handling. This refers to operating practice or recommended practice relating to locomotive and rail car coupling speed.

Under our operating rules for Enginemen, rule 939 reads, quote, "While switching, they must give close attention to signals. The locomotive must be handled with great care when making couplings", end quote.

When it comes to specifying the actual speed when making a coupling, we rely on our time-table rule 25, as pictured below.



55

25. **AVOID DAMAGE — SWITCH CUSTOMERS' CARS CAREFULLY**

OVERSPEED Couplings are DAMAGING — Here's what happens

4 miles per hour ☐		**SAFE COUPLING SPEED**
5 miles per hour ☐ ▬		Damage begins
6 miles per hour ☐ ▬	2 1/4	times as damaging as 4 MPH
7 miles per hour ☐ ▬	3	times as damaging as 4 MPH
8 miles per hour ☐ ▬	4	times as damaging as 4 MPH
9 miles per hour ☐ ▬	5	times as damaging as 4 MPH
10 miles per hour ☐ ▬	6	times as damaging as 4 MPH

Damage to freight or car can be avoided by always keeping coupling speed within the safe range - **NOT OVER 4 MILES PER HOUR - A BRISK WALK.**

HANDLE FREIGHT CAREFULLY AND KEEP OUR CUSTOMERS!

Throughout our rule structure in Operating and Safety rules and instructions, we refer to safe coupling speeds, handling locomotives and cars carefully when making a coupling, etc., but time-table rule 25 is the only regulation that specifies an actual speed.

cc E.P. Herrick

Sincerely, R S Eno

Reproduced from best available copy.

THE DETROIT AND TOLEDO SHORE LINE RAILROAD COMPANY
131 WEST LAFAYETTE AVENUE
DETROIT, MICHIGAN 48226

W. G. BLADES
VICE PRESIDENT & GENERAL MANAGER

February 15, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Referring to your letter of January 3, 1979, addressed to President Adams of the Detroit and Toledo Shore Line Railroad, which he has forwarded to me to answer concerning your request for any information we have relating to locomotive and rail car coupling speed.

Enclosed please find copy of page 19 of current DTSL Timetable No. 34 which, under Equipment Restrictions, Paragraph 4, Sub-paragraph C, Item 2, states "When coupling cars, speed of 4 miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading".

Yours truly,

W. G. Blades
Vice President and
General Manager

(Continued from page 18)

D&TSL FOOTNOTES (Continued)

3 INTERLOCKINGS (Continued)

3.4 Drawbridge.
N&W . . . . Mileage 46.9 (River Rouge) . . . . Mechanical.

3.5 Railway crossing at grade.
CR . . . . Mileage 46.8 (Victoria Avenue) . . . . Controlled.
Contact Operator River Rouge Bridge for instructions.

3.6 Railway crossing at grade.
CR . . . . Mileage 43.5 (Ecorse) . . . . Mechanical.
Operated by CR Trainman.
Normal position clear for D&TSL.

3.7 Railway crossing at grade.
CR/DT&I . . . . Mileage 37.3 (FN) . . . . Mechanical.

3.8 Railway crossing at grade.
CR . . . . Mileage 34.7 (Edison) . . . . Controlled.
Contact D&TSL Train Dispatcher for instructions.

3.9 Railway crossing at grade.
CR . . . . Mileage 34.1 (Denby) . . . . Controlled.
Contact D&TSL Train Dispatcher for instructions.

3.10 Railway crossing at grade.
CR . . . . Mileage 18.7 (Ford Crossing) . . . . Controlled.
Contact D&TSL Train Dispatcher for instructions.

3.11 Railway crossing at grade.
CR . . . . Mileage 17.4 (Monroe) . . . . Controlled.
Contact D&TSL Train Dispatcher for instructions.

3.12 Railway crossing at grade.
CR . . . . Mileage 16.8 (Plum Creek) . . . . Controlled.
Contact D&TSL Train Dispatcher for instructions.

3.13 Railway crossing at grade.
TT . . . . Mileage 0.6 (Boulevard) . . . . Controlled.
Contact TT Train Dispatcher for instructions.

4 EQUIPMENT RESTRICTIONS

4.1 (A) Back-Up and Forward Pushing Movements (Freight Equipment):

(1) To prevent jack-knifing of diesel units during these movements, the following limits are placed on the number of working units permitted whenever 20 or more cars are involved:

1800 H.P. or smaller — 3 units
2000 H.P. or larger — 2 units

The units allowed to work must be those leading in the direction of the movement (next to the cars) and the then trailing units, if any, must be isolated until movement completed. Any dead or idling units located between the operating units and the cars must be set off before movement is started.

4 EQUIPMENT RESTRICTIONS (Continued)

(B) Engine and Tonnage Restrictions:

The maximum number of working units permitted in any engine consist is restricted to 24 motorized axles and the permissible tonnage is restricted to an amount which can be handled by 18 motorized axles.

(C) Coupling Regulations:

When coupling an engine consist of 3 or more units to a train, or cut of cars, a stop must first be made between 6 and 12 feet from point of coupling. The coupling is then to be made as gently as possible.

(1) Before making a coupling to passenger equipment or outfit cars that may be occupied, stop must first be made not less than 6 feet and not more than 12 feet from the point where coupling is to be made.

(2) When coupling cars, speed of four miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading.

(D) To guard against damage to equipment or injury to employees or others, cars equipped with tie-down chains must not be moved until chains are properly secured in a manner that they can not fall off and drag.

On cars equipped with storage boxes, chains must be stored therein when not in use.

On cars equipped with chains attached to top of stakes, chains must be suspended inside stake and positioned behind retaining bar when not in use.

(E) When handling multi-level, TOFC, hydro-cushion roller bearing equipment and all cars 60 ft. and longer, extreme care must be taken to couple, uncouple, separate cars on straight track, and insure that cars are standing at rest.

(1) Due to the length of such cars and the fact that the trucks are recessed from the end, special care must be given to see that they are shoved into clear when switching is to be performed on adjacent tracks.

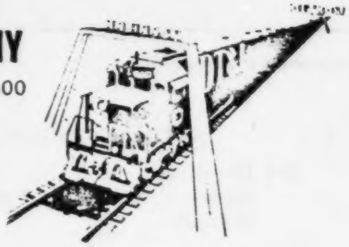
(2) Before coupling onto such cars, a stop must be made not more than 10 feet away and draw bar alignment checked to determine if the draw bars line up and will not slip by.

(3) Extreme care must be exercised through turnouts and sharp curvature to insure that such cars will not be truck-bound or that the corners will not bind due to curvature of track.

(4) Sensitivity of roller bearing or delayed slack action in hydro-cushion underframe or shock absorbing drawbar equipment, and

(Continued on page 20)

DETROIT, TOLEDO AND IRONTON RAILROAD COMPANY
ONE PARKLANE BOULEVARD • DEARBORN, MICHIGAN 48126 • (313) 336-9600



January 16, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In response to your letter of January 3rd requesting information on rail car coupling speeds, please find attached the inside rear cover of DT&I's latest Time Table. I have also attached the front cover for your ease in identification.

I trust this information will prove helpful to you.

Yours truly,

Geo Stern ea

G. L. Stern
Vice President-Operations

GLS:ea
Attchs.

CC: Mr. W. H. Demsey - AAR

AVOID DAMAGE—SWITCH CUSTOMERS CARS CAREFULLY

JUDGING SPEED

Accurate judgment of coupling speed depends upon correct timing. An excellent way to get accurate timing without a watch is to count "one hundred and thirty-one, one hundred and thirty-two" and so on as the car passes a stationary point. With a little practice counting can be done at the rate of one a second.

Ability to closely estimate speed at time car strikes is extremely important because impact force builds up as the square of the speed. This means that impact delivered by a car coupled at 8 mph is not four times that at 2 mph but 16 TIMES AS GREAT. Damage to freight and car can be avoided by always keeping coupling speed within the safe range—**NOT OVER 4 MILES PER HOUR —A BRISK WALK.**

Impact Force At Various Striking Speeds

	Car Coupled at		Units of Destruction
Safe	1	mph	1
	2	"	4
	3	"	9
	4	"	16
Damaging	5	"	25
	6	"	36
	7	"	49
	8	"	64
	9	"	81
	10	"	100

To Find Coupling Speed of 40 Foot and 50 Foot Cars

Sight vertical end of car body on a fixed point and note the number of seconds it takes car to pass. Speed in miles per hour is shown opposite.

Damage as a result of Rough Handling makes up a large part of the claim bill for Loss and Damage to Freight. From the Railroad standpoint it is the major item in the expense. We all know that Rough Handling can be reduced, often eliminated. It is hoped that this table will be helpful in your efforts to prevent Rough Handling.

Switch crews must function as a team. Clear signals properly given are mighty important; talk it over . . . Prevent Rough Handling . . . **It can be done.**

Seconds	Car Miles Per Hour 40 Foot	Car Miles Per Hour 50 Foot
1..	28	..35
2..	14	..17.5
3..	9.3	..11.6
4..	7	.. 8.7
5..	5.6	.. 7
6..	4.7	.. 5.9
7..	4	.. 5
8..	3.5	.. 4.4
9..	3.1	.. 3.9
10..	2.8	.. 3.5
11..	2.5	.. 3.1
12..	2.3	.. 2.9
13..	2.15..	2.7
14..	2	.. 2.5

DO IT THE SAFE WAY

DULUTH MISSABE AND IRON RANGE RAILWAY COMPANY

SUPERINTENDENT'S OFFICE • PROCTOR, MINNESOTA 55810

B. L. WAGNER
Superintendent

January 10, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

This is in response to your letter dated January 3, 1979, wherein you requested information on whether the Duluth, Missabe and Iron Range Railway Company has at this time in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed; and also requesting copy of such rule or recommended practice, if there is one in effect.

Operating employees in switching service on this carrier are governed by several published rules, as concerns the manner in which couplings are to be made. Photo-copies of each of the following applicable rules are attached to this paper, and all such rules have previously been furnished to employees engaged in yard switching service:

Exhibit 1. Consolidated Code of Operating Rules, Edition of 1967, Rules 808, 810, 812.
Exhibit 2. TimeTable No. 92, General Instructions Rules A-22, 35.
Exhibit 3. B.E. Pamphlet 20-B, 1976, Section 174.589, Part (c)
Exhibit 4. B.E. Pamphlet 20, 1977, Section 174.83, Parts (a,b) and Section 174.84.

This carrier also has impact recording devices that are positioned on freight cars periodically to determine the impact of coupling speeds in yards.

Please contact me if I can be of further assistance.

Yours truly,

B. L. Wagner.
SUPERINTENDENT

Attachments: 4

cc: Mr. M.G. Alderink, Gen'l Supt.
D.M.&I.R. Railway Co.

Consolidated Code of Operating Rules

The rules herein set forth govern the railroads operated as listed. They take effect June 1, 1967, superseding all previous rules and instructions inconsistent therewith.

Special instructions may be issued by proper authority.

DULUTH, MISSABE AND IRON RANGE
RAILWAY COMPANY
D. B. SHANK, *Vice President and*
General Manager

808. Employes performing switching must do so efficiently and in a manner which will avoid personal injury, damage to contents of cars, equipment, structures or other property.

810. The following equipment must not be unnecessarily switched with nor couplings made in such a manner as may cause damage to equipment or load:

Flexivan or TOFC cars;
Outfit cars;
Passenger equipment;
Cabooses;
Multi-level loads;
Cars containing livestock;
Open top loads subject to shifting.

812. Trains and engines must be handled in a manner that will avoid shock from abrupt stopping, starting, or slack action, which might result in discomfort or injury to persons or damage to property.

Conductors must call the attention of engineers to any rough handling as soon as the information can be given, and will make prompt report to the Superintendent of any improper handling of trains.

Reproduced from
best available copy.

Duluth, Missabe and Iron Range Railway Company

SAFETY
DULUTH
MISSABE
AND
IRON RANGE
FIRST

Time Table No. 92

EFFECTIVE
12:01 A. M.
CENTRAL STANDARD TIME

JANUARY 1, 1979

(Including Special Instructions)
FOR THE GOVERNMENT OF EMPLOYEES ONLY

M. S. TOON
President

D. B. SHANK
Vice Pres. & General Manager

M. G. ALDERINK
General Superintendent

B. L. WAGNER
Superintendent

GENERAL INSTRUCTIONS

A All Locations or Both Divisions:

22. When handling cars loaded with wire mesh, rail, or ties, cars must be shoved to coupling. These cars must not be kicked or dropped while switching under any circumstances.

35. FRA Emergency Order No. 5 issued October 27, 1974, requires that DOT specifications 112A and 114A Tank Cars, not equipped with FRA approved head shields transporting *flammable gasses*, must not be cut off while in motion and no car moving under its own momentum shall be allowed to strike these cars. Such cars must not be coupled to with more force than is necessary to complete the coupling.
Shipping papers must carry the notation "DOT 112A or DOT 114A must be handled in accordance with FRA E.O. No 5." Employees must be informed of the presence of these cars and instructed to handle them in accordance with the requirements of this order. All switch lists and train lists must be plainly marked to indicate when cars are loaded with *flammable gas.*

B. E. Pamphlet 20-B

Revised January 1, 1976

FOR
YARDMASTERS
YARD CREWS
AND
YARD CLERKS

This pamphlet, containing excerpts from the D.O.T. Regulations, has been prepared for the employees designated above to assist and educate them in their particular duties. It is essentially a ready reference for normal conditions and R. M. Graziano's Tariff No. 30 should be available for information not contained in this pamphlet.

Section Reference

(c) Switching cars containing explosives, poison gas, or flammable poison gas or placarded trailers on flat cars. A car placarded "Explosives," "Poison Gas," or "Flammable Poison Gas," or any flat car carrying a trailer placarded "Explosives," "Poison Gas," "Dangerous," or "Dangerous—Radioactive Material" shall not be cut off while in motion. No car moving under its own momentum shall be allowed to strike any car placarded "Explosives," "Poison Gas," or "Flammable Poison Gas," or any flat car carrying a trailer placarded "Explosives," "Poison Gas," "Dangerous," or "Dangerous—Radioactive Material," nor shall any such car be coupled into with more force than is necessary to complete the coupling.

Reproduced from
best available copy.

B. E. PAMPHLET 20

HAZARDOUS MATERIALS
REGULATIONS
EXCERPTED
FOR
RAILROAD EMPLOYEES

Telephone 202 293-4048

(This number may be reached on a 24 hour basis)

D IN U.S.A.

1977

PART VII SWITCHING

§ 174.83 Switching of cars containing hazardous materials. **(a)** In switching operations where the use of hand brakes is necessary, a loaded placarded tank car, or a draft which includes a loaded placarded tank car, may not be cut off until the preceding car or cars clear the ladder track and the draft containing the loaded placarded tank car, or a loaded placarded tank car, shall in turn clear the ladder before another car is allowed to follow. In switching operations where hand brakes are used, it must be determined by trial whether a loaded placarded car, or a car occupied by a rider in a draft containing a placarded car, has its hand brakes in proper working condition before it is cut off.

(b) A car placarded **"EXPLOSIVES A"** or **"POISON GAS"** may not be cut off while in motion or coupled into with more force than is necessary to complete the coupling. No car moving under its own momentum shall be allowed to strike any car placarded **"EXPLOSIVES A"** or **"POISON GAS"**.

NOTE — DOT specification 112A and 114A tank cars, not equipped with head shields, containing flammable gas, and placarded Flammable Gas, **MUST NOT:**
(1) Be cut off in motion;
(2) Be struck by any car moving under its own momentum; or,
(3) Be coupled into with more force than is necessary to complete the coupling.

§ 174.84 Switching of flatcars carrying placarded trailers or freight containers. **(a)** A placarded flatcar or a flatcar carrying a placarded trailer or freight container that bears any placard prescribed by Part 172 of this subchapter may not be cut off while in motion.

(b) No rail car moving under its own momentum may be permitted to strike any placarded flatcar or any flatcar carrying a placarded trailer or freight container.

(c) No placarded flatcar or any flatcar carrying a placarded trailer or freight container may be coupled into with more force than is necessary to complete the coupling.

DWP

Duluth, Winnipeg & Pacific Railway Co.
J. F. Corcoran
General Manager
72nd Ave. West & Raleigh Street
Duluth, Minnesota 55807

January, 18, 1979

Mr. Henry E. Thomas
Director
Standards & Regulations
U. S. Environmental Protection Agency
Washington, DC 20460

Dear Mr. Thomas:

Per your request letter dated January 3, 1979. A copy of our Special Instructions of our current Time Table #17 dated April 30, 1978 is attached.

I hope this meets your requirements.

Sincerely,

J. F. Corcoran
General Manager

JFC:dll

SPECIAL INSTRUCTIONS—Continued

DWP 3.0 GENERAL INSTRUCTIONS—Continued

3.11 ICE OR MATERIAL IN FLANGE

When required to make switching movements over road crossings where the road surface is covered with snow, ice or mud, crews must first inspect the track in area of the crossing to ensure such movement can be made without derailing. If in doubt, the engine must first be run carefully over the crossing.

3.12 DERAILMENT—PASSENGER AND SERVICE EQUIPMENT

In case of derailment or accident involving service equipment, passenger cars, refrigerator cars and insulated boxes, and with due consideration being given to conditions and their safety, employees affected will shut off supply of propane, oil or methanol at the storage tank outlet.

3.13 PROTECTION—UNATTENDED ENGINES

When diesel units are left unattended, Engineman must be familiar with and adhere to instructions regarding the procedures for protection against the operation of such units by unauthorized persons.

When instructions are received to set off one or more units from a multiple unit consist, Engineman must ensure corresponding reverser levers are left with a responsible person, or in a safe location, advising the Train Dispatcher, so they will be available when required.

3.14 BACK-UP MOVEMENT—THREE OR MORE UNITS

When an engine consist of three or more units is required to make a back-up movement, a member of the crew must be on the leading unit in direction of movement and in position from which signals necessary to the movement can be properly given. He must also be in position to warn persons standing on, or crossing, or about to cross the track.

3.15 EMERGENCY VALVES

All employees concerned must familiarize themselves with the location of emergency valves on engines, cabooses and cars so equipped. These valves are to be used only in case of emergency, and when used, must be fully opened and left open until the movement is stopped.

3.16 SPEEDOMETERS

Employees must familiarize themselves with the location of speedometers in engines, and in cabooses so equipped, and must check speed frequently.

3.17 OBSTRUCTION ON TRACK

Any movement which strikes an obstruction on the track which may cause damage to the movement or which may lodge itself in the running gear must be stopped as soon as possible and be fully inspected. Train Dispatcher must be advised of all such occurrences as quickly as possible.

DWP 3.0 GENERAL INSTRUCTIONS—Continued

3.18 COUPLING REGULATIONS

(A) When coupling cars, speed of four miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading. This applies to all cars including those with cushioned underframes.

(B) Before making a coupling to occupied passenger equipment, stop must first be made not less than six, and not more than twelve feet from the point where coupling is to be made.

(C) Before making a coupling to occupied service equipment, persons in or about these cars must be warned, stop must first be made not less than six, and not more than twelve feet from the point where coupling is to be made.

(D) When coupling an engine consist of three or more units, with or without cars to a train or cut of cars, a stop must first be made not less than six, and not more than twelve feet from point where coupling is to be made.

(E) Before coupling is made with or onto cars equipped with cushion underframes and/or long shank type couplers, the drawbars must be checked to ensure that they are properly lined up. Wherever possible, this type of car should be left on straight track for coupling. If not possible extreme caution must be used when coupling.

(F) Before coupling to or moving passenger and service equipment cars, crews must ensure that there are no wayside electrical cables or sewer pipe connections connected, and that steps from car to ground are removed. They must also ensure that all electrical lines running between cars are connected or otherwise secured before any movement is made.

3.19 AIR BRAKES IN SERVICE

(A) To ensure safe handling of equipment placed on turntables, air brakes or hand brakes must be applied, or equipment properly secured, before engine is uncoupled.

(B) Air brakes must be in service while switching occupied passenger equipment and occupied service equipment, and when switching cars on or off such equipment.

(C) Air brakes must be in service on all cars when switching industrial tracks where there are gates or doors to be opened, or descending grades on any of the tracks to be used.

3.20 EYEGLASSES AND GOGGLES

Eyeglasses or goggles fitted with tinted glass which will not adversely affect either acuteness of vision or color perception may be used for protection against brightness and glare.

Tinted lenses similar to American Optical Cruxite "A" for indoor use, Medium Colorbar for outdoor use, are recommended. The use of lenses where the tint changes according to the amount of light present may be hazardous in working situations where there are sudden

(Continued on page 9)

ELGIN, JOLIET AND EASTERN RAILWAY COMPANY
P. O. BOX 880 · JOLIET, ILLINOIS 60434
815/729-6900

M. R. SEIPLER
GENERAL MANAGER

January 30, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Divn.
United States Environmental
Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

In response to your letter of January 3, 1979 concerning recommended operating practices or operating rules on the Elgin, Joliet and Eastern Railway which would limit coupling speeds on our railroad, the following information is offered.

At present, the only rule on the "J" which limits coupling speed is Safety Rule #63 of the Transportation Department. This rule was formulated to minimize lading damage during switching or humping operations due to overspeed impacts and not to limit noise. The speed of four (4) miles per hour was arrived at through tests carried out by the Damage Prevention Section of the Association of American Railroads.

This rule did not appear in print on the "J" until the most recent issue of the Transportation Department's Safety Rule Book which was effective January 1, 1978. However, the speed of four miles per hour has been used in training session and safety meetings for many years on the "J" when discussing safe coupling speeds.

Attached you will find a copy of "Safety Rules Governing Transportation Department Operating Employes of the Elgin, Joliet and Eastern Railway". Should you require any further information, please contact me.

Yours truly,

MRSeipler

M. R. Seipler
General Manager

Attachment

FLORIDA EAST COAST RAILWAY COMPANY
ONE MALAGA STREET, ST. AUGUSTINE, FLORIDA 32084

OFFICE OF SENIOR VICE PRESIDENT

January 19, 1979

File: 79.14

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

This has reference to your letter of January 3, 1979, to Mr. W. L. Thornton, President, Florida East Coast Railway, pertaining to Environmental Protection Agency broadening the scope of its railroad noise emission standards to include interstate rail carriers' equipment and facilities, and with particular regard to your inquiries concerning coupling speeds in yard operations on FEC.

Florida East Coast Railway does not have any rules specifying specific speeds at which couplings should be made in switching operations. Our Operating Rule 103(a), however, does specify as follows:

> "Care must be exercised in handling cars to avoid damage to equipment or lading."

As you can understand, switching speeds vary depending upon types of equipment being handled and whether or not the equipment is loaded or empty. For that reason, we have not specified any specific rail car coupling speed, but instead require that our employes exercise care in their switching movements in order to avoid damage to the equipment or lading being handled.

Yours very truly,

R. W. Wyckoff
Senior Vice President

RWW/w

cc: Mr. Hollis Duensing, Attorney
Association of American Railroads
1920 "L" Street, N.W.
Washington, D.C. 20036

GEORGIA RAILROAD
THE WESTERN RAILWAY OF ALABAMA
ATLANTA AND WEST POINT RAILROAD COMPANY

M. S. JONES, JR.
PRESIDENT—GENERAL MANAGER

1590 MARIETTA BOULEVARD, N. W.
ATLANTA, GEORGIA 30318

January 29, 1979

Mr. Henry E. Thomas
Director
Standards & Regulations Division
(ANR-490)
U. S. Environmental Protection Agency
Washington, D. C.
20460

Dear Mr. Thomas:

Please refer to your two letters of January 3, 1979 addressed to me as General Manager - Georgia Railroad and President - Atlanta & West Point Railroad Company - The Western Railway of Alabama, concerning the Agency's plans to broaden the scope of its Railroad Noise Emission Standards to include interstate rail carriers' equipment and facilities in compliance with Court Order of August 23, 1977.

Attached is copy of Page 1 from our System Operating Time Table folder which shows the recommended practice which our people are encouraged to follow closely when coupling cars and locomotives.

If we can be of further assistance in any way, please let us know.

Sincerely,

MSJones Jr

M. S. Jones, Jr.

AAW/am

STANDARD CLOCKS

Augusta-Harrisonville, Camak, Union Point, Macon, Atlanta Yard, Atlanta Shop, Opelika, Chester, Selma.

TRACK SCALES

Location	Capacity	Length
Harrisonville	150 Ton	50 Ft.
Camak	100 "	50 "
Camak Quarry	125 "	50 "
Athens	100 "	42 "
Atlanta	125 "	50 "
Montgomery	150 "	50 "
Selma	125 "	50 "

SPEED TABLE

This table is for information in determining speed per mile and in no way affects rules governing speed of trains.

Miles per Hour	1 Mile in		Miles per Hour	1 Mile in		Miles per Hour	1 Mile in	
	Min.	Sec.		Min.	Sec.		Min.	Sec.
6	10		28	2	8	45	1	20
8	7	30	29	2	4	46	1	18
10	6		30	2		47	1	16
12	5		31	1	56	48	1	15
15	4		32	1	52	49	1	13
16	3	45	33	1	49	50	1	12
17	3	31	34	1	45	51	1	10
18	3	20	35	1	42	52	1	9
19	3	9	36	1	40	53	1	7
20	3		37	1	37	54	1	6
21	2	51	38	1	34	55	1	5
22	2	43	39	1	33	56	1	4
23	2	36	40	1	30	57	1	3
24	2	30	41	1	27	58	1	2
25	2	24	42	1	25	59	1	1
26	2	18	43	1	23	60	1	
27	2	13	44	1	21			

ABBREVIATIONS

B – Base radio station – L&N frequency
C – Base radio station – dispatcher control
DO – Defect detector
O – Track other than siding
R – Base radio station

PIGGYBACK RAMPS

Location	Trailer must be pointed
Augusta	East
Thomson	East
Union Point	East
Covington	East
Conyers	West
Athens	East
Lithonia	East
Stone Mountain	East
Atlanta	West
College Park	West
LaGrange	West
Montgomery	West

HOW TO JUDGE IMPACT FORCE AND SPEED OF FREIGHT CARS

For the benefit of those engaged in train or yard service, there is shown below the impact force at various speeds, together with methods of calculating speed of 40-foot car. This information should enable switching crews to couple cars at proper speed, thereby reducing damage to lading and subsequent claim payments.

The factor behind damage resulting from rough coupling of cars is; impact delivered by coupled cars increases in proportion to square of the speed. In other words, a car coupled at 8 miles per hour delivers 16 times as much impact force as a car coupled at 2 miles per hour.

The coupling speed of a 40-foot car may be determined by sighting the vertical end of car against some stationary object like a telegraph pole, switch stand or crosstie and noting the seconds it takes to pass. Speed in miles per hour is shown below. (A good way to count seconds without using a stop watch is to count "one hundred and thirty one, one hundred and thirty-two" and so on as the car passes a stationary point.)

Figuring Speed of 40-Foot Car

Seconds	Miles Per Hour
1	28
2	14
3	9.3
4	7
5	5.6
6	4.7
7	4
8	3.5
9	3.1
10	2.8
11	2.5
12	2.3
13	2.15
14	2

Impact Forces at Striking Speeds

Car Coupled at	Units of Destructive Force
1 mph	1
2 mph	4
3 mph	9
4 mph	16
5 mph	25
6 mph	36
7 mph	49
8 mph	64
9 mph	81
10 mph	100

A safe range of speed is a brisk walk, which is about 4 miles per hour.

Grand Trunk Western Railroad Co.
W. Glavin
Vice President-Administration
131 West Lafayette Boulevard
Detroit, Michigan 48226

January 18, 1979

Mr. Henry E. Thomas, Director
Standards & Regulations Division
(ANR-490)
United States Environmental
Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

The Grand Trunk Western Railroad, like many rail properties, in the interest of protecting lading and equipment, subscribe to a coupling speed of 4 MPH or less.

While we do not have any operating rule, it has been and continues to be our practice for our operating supervisors to observe switching operations and to make sure the coupling speed of no greater than 4 MPH is followed. Coupled with safety meetings, loss and damage meetings are held with train and engine crews in attendance. At these meetings the 4 MPH or less coupling speed is discussed with the reasons for compliance pointed out.

Loss & Damage Supervisor makes spot checks in switching yards using a radar gun, making a report to the top operating officer. This report shows actual coupling speeds, and any excessive speeds are handled for correction with the local supervision in charge.

Very truly yours,

GREEN BAY ROUTE

J. J. BRULEY
Superintendent

GREEN BAY AND WESTERN RAILROAD COMPANY

P. O. BOX 2507 GREEN BAY, WISCONSIN 54306 414-497-5114

January 8, 1978

File: 840-14

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your letter of January 3, 1979, directed to Mr. H. W. McGee has been turned over to me for handling.

The Green Bay and Western Railroad Company has an operating practice of freight car coupling speeds not to exceed four (4) miles per hour.

These instructions are contained in our current Timetable No. 92, page seven (7). A copy of this page is attached.

Yours very truly,

JJB/bd
Enclousre

AVOID DAMAGE – Switch Customers Cars Carefully

– JUDGING SPEED –

Accurate judgement of coupling speed depends upon correct timing. An excellent way to get accurate timing without a watch is to count "one hundred and thirty-one, one hundred and thirty-two" and so on as the car passes a stationary point. With a little practice counting can be done at a rate of one a second.

Ability to closely estimate speed at time car strikes is extremely important because impact force builds up as the square of the speed. This means that impact delivered by a car coupled at 8 miles per hour is not four times that at 2 miles per hour, but 16 TIMES AS GREAT. Damage to freight or car can be avoided by always keeping coupling speed within the safe range – NOT OVER 4 MILES PER HOUR – A BRISK WALK.

IMPACT FORCE AT VARIOUS STRIKING SPEEDS

	Car Coupled at	Units of Destructive Force
Safe	1 mph	1
	2 "	4
	3 "	9
	4 "	16

	Car Coupled at	Units of Destructive Force
Damaging	5 mph	25
	6 "	36
	7 "	49
	8 "	64
	9 "	81
	10 "	100

OFFICE HOURS OF OPERATORS

Manawa	7:45 AM to 4:45 PM	Mon. thru Friday
Plover	9:00 AM to 6:00 PM	Mon. thru Sat.
Wis. Rapids	8:00 AM to 4:00 PM	Daily
	4:00 PM to Midnight	Mon. thru Friday
	Call for No. 1	Sat. and Sun.
Merrillan		Continuous
Winona		Call
Kewaunee		Call

OFFICE HOURS OF TRAIN DISPATCHERS

Norwood	Continuous
Wats Phone Number	800–242-2937

– SPEED CARD –

To Find Coupling Speed of 40 Foot and 50 Foot Car

Sight vertical end of car body on a fixed point and note the number of seconds it takes car to pass. Speed in miles per hour is shown opposite. Damage as a result of Rough Handling makes up a large part of the claim bill for Loss and Damage to Freight. From the Railroad standpoint it is the major item in the expense. We all know that Rough Handling can be reduced, often eliminated. It is hoped that this card will be helpful in your efforts to prevent Rough Handling.

Switch Crews must function as a team. Clear signals properly given are mighty important; talk it over – prevent Rough Handling – it can be done.

Seconds	40 Ft. Car Miles Per Hour	50 Ft. Car Miles Per Hour
1.	28	35
2.	14	17.5
3.	9.3	11.6
4.	7	8.7
5.	5.6	7
6.	4.7	5.9
7.	4	5
8.	3.5	4.4
9.	3.1	3.9
10.	2.8	3.5
11.	2.5	3.1
12.	2.3	2.9
13.	2.15	2.7
14.	2	2.5

HOUSTON BELT & TERMINAL RAILWAY COMPANY

UNION STATION BUILDING
OPERATING THE TERMINALS OF

MISSOURI PACIFIC RAILROAD CO
FORT WORTH AND DENVER RAILWAY CO
L. B. GRIFFIN
PRESIDENT AND GENERAL MANAGER

ATCHISON, TOPEKA AND SANTA FE RAILWAY CO.
CHICAGO, ROCK ISLAND AND PACIFIC RAILROAD CO
HOUSTON, TEXAS 77002

January 30, 1979

File: 140.31-2

Mr. Henry E. Thomas, Director
Standards and Regulations Division
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Reference is made to your letter of January 3 with respect to our speed of impact requirements in rail car coupling.

The Houston Belt & Terminal Railway Company is a party to a Code of Operating Rules in which Section 103(a) reads as follows:

Precautions in switching. ------------X X X X X X X X (1) X X X X X X X X X X X X X X X

(2) When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient hand brakes. Make couplings at a speed of not more than 4 miles per hour.

Yours very truly,

L B Griffin

Illinois
Central
Gulf

An IC Industries Company

William F. Bunn
General Solicitor

Illinois Central
Gulf Railroad
Two Illinois Center
233 North Michigan Avenue
Chicago, IL 60601
(312) 565 1600

January 17, 1979

United States Environmental
Protection Agency,
Washington, D. C. 20460

Attention: Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)

Gentlemen:

Receipt is acknowledged of letter from Mr. Thomas to our President W. J. Taylor dated January 3, 1979 and requesting information regarding Illinois Central Gulf operating rules, operating practices or recommended practices relating to locomotive and rail car coupling speed.

Our General Superintendent Administration J. F. Reents has called my attention to two operating rules that would bear upon this subject. Copy of his letter to me dated January 17, 1979 is forwarded in that regard. He also informed me that instructions are issued to train, yard and engine service employees to avoid impact between locomotives and cars, or between cars in excess of four miles per hour. This is exemplified by such pamphlets as the attached "Responsibilities of the Yard Engine Foreman" and "Careful Car Handling Guide" and the several posters that have issued out of the ICG Freight Claim Department.

With every good wish, I remain

Very truly yours,

William F. Bunn

Attach.

Chicago, January 17, 1979

TO: Mr. W. Bunn

FROM: J. F. Reents

SUBJECT: Request for Information from Environmental Protection Agency for Information in Connection with Rules, Operating Practices or Recommended Practices Relating to Locomotive and Rail Car Coupling Speed

Referring to letter, dated January 3, 1979, addressed to Mr. W. J. Taylor from the Environmental Protection Agency (EPA), concerning scope of railroad noise emissions.

The Operating Department and Transporation Department rules have general regulations in connection with coupling of locomotives and cars. Rule 103(a) states:

> "Running switches will be made only when they can be made without danger to employees or damage to equipment or contents of cars. Before making the switch, it must be known the tracks have sufficient room; and that the switch and hand brakes must be tested and known to be working properly. Cars must have sufficient momentum only to move them into clear. The switch must not be thrown unless there is sufficient room between the equipment for it to be done safely. Employees must be on the alert to avoid collision if the switch is not thrown. Engine must be run on straight track when practical."

Rule 804 states in instructions to engineman:

> "They must exercise good judgment in starting and stopping trains and coupling and switching cars, to avoid discomfort or injury to passengers or employees or damage to property. Slack in trains must be properly controlled to avoid rough handling."

We also have instructions issued to train, yard and engine service employees to avoid impact between locomotives and cars, or between cars in excess of four miles per hour because of the possibility of damage to locomotives, damage to lading in cars, and to the cars themselves.

The freight claim prevention people have issued numerous practices' guidelines to train and yardmen in connection with the desirable coupling speed. Attached is a calendar covering the year 1979. If you will review the backside, you will observe the findings covering safe coupling speed. In addition is a copy of the careful car handling guide, responsibility of yard enginemen, and numerous posters that have been prepared and issued to train, yard and engine service employees.

Sincerely,

J. F. Reents
General Manager - Administration

RESPONSIBILITIES OF THE YARD ENGINE FOREMAN

I. Responsible for the performance of all crew members in performing safe, efficient, damage-free switching.

II. Prepares to perform switching.

- A. Sees that all members of the crew report to work on time, properly dressed and equipped to perform duties.
- B. Receives instruction from the yardmaster or trainmaster concerning the priority of switch functions to be performed.
- C. Plans switch work to be done.
- D. Shares plan with crew.
- E. Insures that all crew members are familiar with Operating Department rules and safety rules.
- F. Insures that crew members are familiar with their duties, instructing if necessary.
- G. Reviews switch lists for cars requiring special handling.

III. Avoids or reduces switching impacts.

- A. Shove or reswitch stalled cars rather than driving them to a coupling with following cars.
- B. Secure cars in tracks with hand brake or chock.
- C. Be sure hand brake is released and air released when switching.
- D. See knuckles are open to assure coupling and eliminate jammed knuckles.
- E. Handle as small a cut as possible in switching to minimize slack action within the cut.
- F. Make coupling 1-1/2 m.p.h. or less when motive power is attached.

IV. Make free rolling couplings 4 m.p.h. or less.

- A. Give clear signals and require prompt response to signals given to:
  - 1. Engineer for control of engine.
  - 2. Helper for switch alignment.
- B. Estimate speed at which car must be released by using knowledge of:
  - 1. Grade variance of yard and switching lead.
  - 2. Distance the car must travel to couple.
  - 3. Loaded or empty.
  - 4. Approximate weight of car.
  - 5. Wind and temperature.
  - 6. Type of journal bearing.

V. Gives special handling to cars designated or observed to require special handling.

- A. Obeys rules governing Orange "X" bad order cars.
- B. Does not move or gives minimum movement to a leaking car -- notifies proper authority for repair.
- C. Does not move cars with refrigerator or plug door open.
- D. Does not move or gives minimum movement to cars which are observed to be unsafe for normal movement --- notifies proper authorities for repair.

VI. Sets pace of switching to produce quality service - quality transportation service.

- A. Considers safety.
- B. Considers sequence of switch moves to effect efficiency.
- C. Considers careful car handling.

R. K. Osterdock, Gen. Supt. Yards & Terminals

Illinois Terminal Railroad Company

W. J. CASSIN
PRESIDENT

710 N. TWELFTH BOULEVARD
P.O. BOX 7282
ST. LOUIS, MO. 63177

"The Road of Personalized Services"

January 13, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
United States Environmental Protection Agency
1921 Jefferson Davis Highway
Arlington, Virginia 20460

Dear Mr. Thomas:

Reference your letter of January 3, 1979, regarding railroad noise emission standards. The Illinois Terminal Railroad Company has the following operating rules and special instructions relating to locomotive and rail car coupling speed:

103: "When cars are shoved by an engine, and the conditions require, a trainman must take a conspicuous position on leading car, and at night he must display a white light."

103(a): "Running switches will be made only when they can be made without danger to employes, or damage to equipment or contents of cars. Before making the switch it must be known that tracks have sufficient room; and the switch and hand brakes must be tested and known to be working properly. Cars must have sufficient momentum only to move them into clear. The switch must not be thrown unless there is sufficient room between equipment for it to be done safely. Employes must be on the alert to avoid collision if the switch is not thrown. Engine must be run on straight track when practical.

Cars containing explosives, poison gas or dangerous-radioactive material, must not be kicked or dropped. Other cars must not be kicked or dropped into a track against such cars.

Running switches must not be made when movements are controlled by interlocking."

103(b): "Cars left standing on a track must be secured, applying sufficient hand brakes when necessary; they must be clear of other tracks; when practical, they must be coupled to other cars and, if on heavy grade, the wheels must be blocked.

When cars are picked up, hand brakes must be released.

When necessary to secure or control cars by hand brakes, it must be known that such brakes are working properly. If hand brakes are defective and cars are left, the cars must be blocked securely and train dispatcher or yardmaster notified.

Before coupling to cars where derailment, damage or injury might result if coupling should miss and cars roll, sufficient hand brakes must be applied on standing cars to prevent them from rolling."

103(c): "When coupling, shoving or switching cars, precaution must be taken to prevent damage or fouling other tracks. It must be known there is sufficient room in track to hold the cars; when necessary, the slack must be stretched to ensure that cars are coupled. When there is a possibility of cars being shoved the entire length of a track or cars rolling entire length of a track, a trainman must go ahead to protect the movement, unless otherwise protected.

When an engine is coupled to a train, coupling must be tested by slacking the engine ahead."

103(d): "When cars are shoved, kicked or dropped over public grade crossing not protected by gates, the crossing must be protected by a member of the crew. Switching cars over such crossings shall be only on signals of a member of the crew at the crossing.

Public grade crossings must not be blocked longer than five minutes when it can be avoided. When parting trains or cuts of cars at such locations, the cars should be left not less than fifty feet from each side of crossing, when practical. Before movement is made to recouple, the crossing must be protected by a trainman.

When a train or cut of cars is parted to clear a public grade crossing or is standing near such crossing, a member of the crew must, when practical, protect the crossing when a train is approaching on another track. Unnecessary operation of automatic public grade crossing signals due to engines or cars standing on circuit is prohibited.

When a train or engine has been stopped on a main track, or is using a track other than a main track, near a public grade crossing where an automatic grade crossing signal is in service, movement over such crossing must be protected by a trainman, unless it is known that the automatic protection has been operating a sufficient time for vehicular traffic.

After passing over public grade crossing protected by automatic grade crossing signals, reverse movement must not be made over the crossing unless the movement is protected."

103(e): "When coupling or switching cars, or cars are cut off in motion, coupling speed must be within safe limits and proper precaution taken to prevent damage. When engines are working at both ends of a track, movements must be made carefully to avoid injury or damage."

103(f): "Before coupling to or moving cars on tracks where cars are being loaded or unloaded, trainmen must see that vehicles and other obstructions are clear of cars; stage boards, elevator spouts, pipe connections to tank cars and similar devices are removed; persons in or about such cars are warned and requested to vacate cars while being switched; and when practical, that the contents of cars are properly trimmed or braced to prevent damage. Information from industry employes does not relieve compliance with these requirements.

Cars not taken must be returned to their original location, unless otherwise instructed."

103(g): "Passenger or camp cars must not be kicked or dropped. Cars must not be kicked or dropped into a track on which there are passenger or camp cars.

Before switching occupied cars, air must be cut in, the system charged and, if dining or camp cars are involved, occupants of such cars notified. Automatic brakes must be used in such switching."

Your particular attention is directed to the above Rule 103(e). We also have a bulletin order which reads as follows:

"Every effort must be made to keep coupling speed of diesel engines to 3 MPH or less; however, when a heavy impact is made by a diesel engine and damage is indicated, it must immediately be shut down and inspected by a member of the Mechanical Department before it is restarted. Such cases must be reported by the quickest available means of communications to the Train Dispatcher, or when they occur in a yard, to the Yardmaster or other employe in charge of the yard."

Yours truly,

WJC:sks

INDIANA HARBOR BELT RAILROAD COMPANY

1740 Transportation Center
Philadelphia, Pennsylvania
January 12, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division
U.S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your January 3 letter inquiring whether Indiana Harbor Belt has an operating rule or practice relating to coupling speeds.

This subject is covered in Rule 130 in our present Book of Rules. Copy of the applicable page is attached.

Sincerely,

R B Hasselman
R. B. Hasselman
President

not protect against following movements unless specified in the timetable.

111. Unless otherwise specified in the timetable, trains and engines using a siding may proceed at Restricted Speed and will not protect against following movements.

A siding of an assigned direction must not be used in the reverse direction without proper signal indication, authority of the employe in charge, or in an emergency under flag protection.

Trains or engines using a controlled siding will operate in accordance with signal indications.

112. On a running track, movements may proceed at Restricted Speed, on signal indication, permission of employe in charge or as specified in the timetable and in an emergency under flag protection. When movement has been completed it must be reported clear; except, when clearing at an interlocking, block station or where switch tenders are on duty. Protection against following movements will not be provided unless specified in the timetable.

113. Movements on tracks other than main, secondary, running tracks and sidings may proceed at Restricted Speed unless otherwise specified in the timetable.

130. Engines and cars must be coupled at a speed, not to exceed 4 miles per hour.

130a. A stop must be made just prior to coupling occupied passenger equipment. Cars occupied by passengers and cars placed on tracks occupied by such cars must be handled with air brakes in service.

130b. Cars placed for loading or unloading, must not be coupled to nor moved until all persons in or about them have been notified and all obstructions under or about the cars, transfer boards, and attachments have been removed. When such cars are moved they must be returned to original location.

Sign reading "Stop-Tank Car Connected," indicates tank cars are connected for loading or unloading and must not be coupled to or moved. Cars must not be placed on the same track that may obstruct the view of a sign without first notifying the person in charge.

Reproduced from
best available copy.

THE KANSAS CITY SOUTHERN RAILWAY COMPANY
LOUISIANA & ARKANSAS RAILWAY COMPANY
114 WEST ELEVENTH STREET
KANSAS CITY, MISSOURI 64105

THOMAS S. CARTER
PRESIDENT

January 16, 1979

Mr. H. E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Reference to your letter January 3, 1979, concerning our regulations with respect to coupling speeds.

Please find enclosed two attachments showing Kansas City Southern Lines Operating Rule 103 (a) (2) which does prohibit our crews from making couplings at speeds greater than four (4) M.P.H.

We received this request in two separate letters, one addressed to the Louisiana and Arkansas Railway Company, the other Kansas City Southern Railway Company. The Operating Rule Book and the appropriate rule does apply for each of these two lines.

Yours very truly,

T. S. Carter

Copied from Operating Rule Book, effective July 1, 1954

ually controlled crossing signals, and they are known to be functioning.

(2) When cars are shoved over crossing and facing end of leading car is equipped with a back-up air brake hose or pipe, and air whistle handled by the trainman.

(3) When yard to yard or long switch or transfer movements shoving cars are protected by a member of the crew on leading car and movement over the crossing is made only on his signal.

When a train or cut of cars is parted to clear a public crossing at grade, a trainman must, when practicable, protect the crossing against trains or engines approaching on adjacent tracks, unless crossing is protected by a watchman or gates.

Trains, engines or cars must not block a public crossing longer than 5 minutes when it can be avoided.

Unnecessary operation of automatic public crossing signals due to engines or cars standing in circuit should be avoided.

103 (a). **Precautions in Switching.**—When cars are shoved by an engine and conditions require, a trainman must take conspicuous position on the leading car.

Employes must observe the following precautions in switching movements:

(1) See that cars left on tracks are properly secured, clear other tracks and, when practicable, clear public crossing at least 75 feet.

(2) When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient hand brakes. Make couplings at a speed of not more than 4 miles per hour.

(3) Before shoving yard tracks, know there is sufficient room to hold the cars. When shoving entire length of track, see that cars are coupled and, unless otherwise provided, send a man to head end to protect the movement.

(4) When necessary to control cars by hand brakes, know that sufficient brakes are in working order before cars are cut off.

(5) Make running switches only when can be made without danger to employes, equipment or contents of cars. Know that the track is sufficiently clear, switches and brakes in working order and run engine on straight track, when practicable.

Running switches must not be made with cars containing inflammables, explosives or other dangerous articles, nor through spring or remote control switches.

(6) Where engines may be working at both ends of a track, have proper understanding between crews involved.

(7) Before coupling to or moving cars on tracks where cars are being loaded or unloaded, see that running boards, oil tank couplings, elevator spouts and similar connections are removed and clear, and persons in, on or about cars are warned and requested to vacate cars while being switched.

(8) Passenger cars and occupied outfit cars must not be kicked or dropped. Other cars must not be kicked or dropped into a track on which passenger or occupied outfit cars are standing.

(9) Before switching passenger equipment or occupied outfit cars, see that brake pipe connections are made, angle cocks opened between the cars and brake system charged. Automatic brake valve only must be used by engineers in such switching.

KANSAS CITY TERMINAL RAILWAY COMPANY

V. E. COE
PRESIDENT & GENERAL MANAGER

KANSAS CITY, MO. 64108

January 9, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

Referring to your letter of January 3, 1979, in regard to noise levels with respect to car coupling speed.

A copy of Kansas City Terminal Rules and Regulations No. 853 is attached.

Yours truly,

V.E. Coe

att.

In the event a penalty application oc- urs, a full service brake application will result.

To obtain a release of a safety control enalty application, it is necessary to place the utomatic brake valve handle in the "suppres- on" position until pressure is restored, after hich the brake valve handle may be returned to elease" position provided the safety control edal is depressed.

The safety control pedal must not be it out, unless defective or otherwise instruc- d. When necessary to cut out a defective fety control pedal the engineman must notify e nearest maintenance point as soon as prac- able.

The cut out cock for this device is entified by the red valve and may be found on e Engineer's side in front of the cab above the gine walk-way.

The use of a weight or a device to ld down the safety control pedal or defeating e safety control feature is prohibited.

When locomotive is left standing, an lependent brake application of approximately pounds or more will keep the safety control vice from actuating.

TRAIN, ENGINE AND YARD SERVICE

850. Conductors and engine foremen re- rt to and receive instructions from the Super- endent and his designated officer. Trainmen d helpers are subordinate to conductor and gine foreman, and fireman to engineman ile on duty.

851. Conductors and engine foremen are ponsible for the strict performance of duty all persons employed on their trains or gines. Each must require the safe management his train or engine, and report to the Yardmaster or Superintendent any misconduct, insubordination or neglect on the part of others whose duties require their cooperation.

852. Employes must see that cars left on tracks are properly secured, clear other tracks and, when practicable, clear public crossings at least 75 feet.

* **853.** When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling and setting sufficient hand brakes. Make couplings at a speed of not more than 4 miles per hour.

854. Before shoving yard tracks, know there is sufficient room to hold the cars.

When shoving entire length of track, see that cars are coupled and, unless otherwise provided, send a man to end of cars to protect the movement.

When shoving cars on tracks equipped with bumping post, wheel stops, etc., a safety stop must be made at least one car length from bumping post, wheel stops, etc., before completing the movement.

855. When necessary to control cars by hand brakes, know that sufficient brakes are in working order before cars are cut off.

856. Make running switch only when it can be made without danger to employes, equipment or contents of cars. Know that the track is sufficiently clear, switches and brakes in working order and run engine on straight track, when practicable.

Running switches must not be made with cars containing flammables, explosives or other dangerous articles, nor through spring or remote control switches.

857. Where engines may be working at

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Kentucky & Indiana Terminal Railroad Company
Office of President & General Manager

[illegible]
JOSEPH J. [illegible]
PRESIDENT & GENERAL MANAGER
Louisville, Ky. 40212

February 26, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
  Division (ANR-490)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your letter February 9 which was received on February 20 requesting information concerning rules or practices relating to couplings speed.

It is our practice to perform car couplings at a proper safe speed but we do not have a rule indicating that couplings should not occur at speeds greater than four miles per hour. The applicable rule in effect on our railroad reads as follows:

> Switching crews must pay special attention to the commodities with which cars are loaded and see that lading, liable to damage by rough handling, is properly protected. Bad order cars in a cut, with defects that would endanger the safety of crew or cause further damage to equipment by switching, should be set out.
>
> Extreme care must be taken in switching trailers and flat car loading, especially at Market Street, to avoid damage.

Very truly yours,

cc: G. L. Adkins

LAKE SUPERIOR & ISHPEMING RAILROAD COMPANY
105 EAST WASHINGTON STREET
MARQUETTE, MICHIGAN 49855

JAMES J. SCULLION
PRESIDENT AND CHIEF EXECUTIVE OFFICER

January 25, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental
Protection Agency
Washington, DC 20460

Dear Mr. Thomas:

In reply to your letter dated January 3 inquiring as to whether or not we have rules on coupling speeds.

We make available to all of our people a small card calendar, issued by the Association of American Railroads, which indicates the safe coupling speeds for various length cars. For the most part, this would average about four miles per hour.

On our particular railroad, we do practically no flat switching and have no retarder yards, which are the most common sources of impact noise. Approximately 99% of our traffic is iron ore. We normally handle cuts of anywhere from 25 to 35 cars and shove to a coupling. This applies at both the mines and boat loading dock and reduces impact noise to an absolute minimum.

On the basis of our operation, we have never felt that rules to cover coupling speeds were necessary.

Sincerely yours,

J. J. Scullion

President and
Chief Executive Officer

JJS:bew

THE LAKE TERMINAL RAILROAD COMPANY
600 GRANT STREET P. O. BOX 536
PITTSBURGH, PA. 15230

W. SPALDING TOON
PRESIDENT

January 12, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This is in response to your letter of January 3 requesting whether or not the Lake Terminal Railroad has in effect at this time an operating rule, operating practice, or a recommended practice relating to locomotive and rail car couplings.

We do not have an operating rule specifically designating a coupling speed. Crews have always been instructed to handle cars carefully when making couplings to prevent damage to contents and equipment.

Very truly yours,

W. S. Toon

President

Members of the Board

Chairman Harold L. Fisher
Vice Chairman Leonard Braun

Lawrence R. Bailey
Donald H. Elliott
Justin N. Feldman
Mortimer J. Gleeson
Edwin G. Michaelian
Daniel T. Scannell
Constantine Sidamon-Eristoff

M
The Long Island Rail Road

Jamaica Station Jamaica, New York 11435 Phone 212 658-1700
212 526-0900

Thomas M. Taranto
General Counsel and
Secretary

January 22, 1979

Mr. Henry E. Thomas
Director, Standards and
Regulations Division
United States Environmental
Protection Agency
Washington, D.C. 20460

Re: Rail Coupling Speed

Dear Mr. Thomas:

Pursuant to your letter request dated January 3, 1979, please be advised that The Long Island Rail Road Company conforms to the general industry standard recommended coupling speed of 4 miles per hour. The special rules for coupling LIRR equipment are enclosed herewith.

If you have any questions, please do not hesitate to call me at (212) 658-1700.

Sincerely yours,

Lawrence H. Rubin
Attorney

LHR/[illegible]
encls.

the independent brake should be applied. Before the brake pipe hoses between the locomotive and the train have been coupled, condensation must be blown from the brake pipe. The locomotive brakes must remain applied while the train is being charged.

To charge a train, use the "release" position of DS-24 or 26-C brake valves and the "running" position of all other types of brake valves.

During the initial charging of a train, the output of the air compressor on a diesel locomotive may be increased when necessary by moving the throttle to "number four" or "number five" position. Before opening the throttle, the generator field or motor control switch must be in "off" position and the reverse lever in "neutral" position. When the main reservoir gauge indicates normal cycling between cut-in and cut-out pressures, the throttle should be reduced to "idle" position for the remainder of the charging time.

If, after coupling the locomotive to the train, it is not the intention to immediately begin charging the train, the automatic brake valve handle should be placed in "lap" position ("handle-off" position on 26-L equipment) until the signal to charge the train has been received.

Reducing valves for ground air lines used for charging and testing air brakes of trains or cuts of cars should be set for a maximum pressure of 70 lbs. for freight and 110 lbs. for passenger.

2. PASSENGER TRAINS

Note: a safety stop must be made just prior to coupling.

Connect the brake pipe and signal line by coupling the air hoses between the cars. Starting with the end nearest the locomotive, first open the brake pipe angle cock slowly, and second, open the signal line cut-out cock. Then, in a similar manner open the angle cocks and cut-out cocks on the balance of the cars. On all cars, see that the cut-out cocks in the brake pipe branch pipes are open, and that all hand brakes are released.

The graduated release feature on all passenger cars must be set for graduated release.

3. PASSENGER TRAINS – FREIGHT CARS HANDLED

When freight cars are to be operated either permanently or temporarily in passenger service, the brake cylinder or its pipe should be equipped with a safety valve adjusted to open at approximately 60 lbs. Cars may be operated without this safety valve, but the engineer in charge of the train must be so notified. In such cases, the engineer will operate the train brakes under normal conditions in such a manner as to avoid a service brake cylinder pressure in excess of 60 lbs. at speeds of less than 25 mph.

The pressure-retaining valves must be set in the "direct exhaust" position (handle pointing downward).

4. PUSH-PULL TRAINS

a. Follow the instructions contained in Paragraphs 1 and 2, except in the case of the signal line hose.

b. Brake pipe and main reservoir cut-out cock handles are accessible on the car step riser and are interlocked. To cut in the air, pull out the brake pipe handle (upper rod), then pull out the main reservoir handle (lower rod). This locks the brake pipe cock in the open position. To cut out the air, push in the main reservoir handle (lower rod), then push in the brake pipe handle (upper rod).

c. Before coupling or uncoupling electrical jumpers, it is imperative that the power car isolation switch be turned to the "idle" position.

5. M-1 TRAINS

Brake pipe and electrical connections are automatically made up when pairs of cars are coupled.

a. Coupling

Make a complete stop just prior to coupling and check for proper coupler alignment. Bring the two cars gently together to couple and latch to each other. It will be known that brake pipe communication has been established when a brake pipe emergency application takes place.

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L&N
LOUISVILLE & NASHVILLE RAILROAD COMPANY
908 W. BROADWAY • LOUISVILLE, KENTUCKY 40203 TELEPHONE (502) 587-5476

LAW DEPARTMENT

ROY L. SHERMAN
GENERAL ATTORNEY

January 18, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your letter of January 3, 1979, inquiring whether this Company has in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed.

The L&N does not have a published operating rule in effect relating to coupling speed. However, this Company follows the practice recommended by the Association of American Railroads that cars not be coupled at a speed greater than four miles per hour. Enclosed is a copy of a pamphlet entitled Careful Car Handling published by the AAR. You will note therefrom that the recommended practice is contained on both pages four and five.

This pamphlet is used by our Loss and Damage Prevention Section for dissemination in its program to minimize lading damage.

Sincerely yours,

Roy L. Sherman

Roy L. Sherman.

Enclosure

MAINE CENTRAL RAILROAD COMPANY

342 ST. JOHN STREET PORTLAND, MAINE 04102
TELEPHONE (207) 773-4711 TELEX 94-4422

JOHN F. GERITY
PRESIDENT

January 15, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Pursuant to the request contained in your letter of January 3, 1979, for information with respect to rules in connection with rail car coupling speed, attached is copy of Rule 113 of Maine Central Railroad Company's "Rules of the Operating Department."

I trust this will give you the desired information.

Yours sincerely,

J F Gerity

John F. Gerity

JFG/ms
Enclosure

cc: Mr. A.J.Travis,
Executive Vice President

exceed speed restrictions applying on that track, and must not exceed a maximum speed of 30 miles per hour.

110b. The following maximum speeds must not be exceeded:

Over any drawbridge .... 30 MPH
And brakes must not be applied on drawbridges except in an emergency.
Circus and Carnival trains :
On Main Lines .... 30 MPH
On Branch Lines .... 25 MPH

111. In switching passenger equipment the air brakes must be in use while handling occupied equipment, and when coming onto passenger trains or drafts made up for occupancy or placed on station tracks regardless of whether occupied or not.

Cars must not be uncoupled while in motion.

Engines or drafts coming onto occupied passenger equipment must make full stop before coupling on.

In switching caboose cars, under no circumstances are they to be kicked. Follow the same plan switching caboose cars as passenger equipment, not uncoupling caboose until it has stopped, and in coupling onto caboose cars that are occupied, or that may be occupied, engines will come to full stop before coupling on.

111a. Tracks at various locations must be switched with air brakes in use because of grades or other conditions. Such tracks are identified by a sign near the switch indicating air brakes must be used while switching.

Other locations where air brakes must be coupled and in use while switching will be indicated in Time-Table Special Instructions.

112. A sufficient number of hand brakes must be applied on cars left at any point to prevent them from moving. If left on a siding they must be coupled to other cars, if any, on such track unless necessary to separate them at public crossings or otherwise. Before coupling to cars at any point care must be taken to insure that cars being coupled to are properly secured.

113. When coupling cars together, speed of four miles per hour at time of coupling must not be exceeded to avoid damage to equipment and lading.

During flat switching operations when cuts of twenty or more cars, including loads subject to damage from overspeed impacts, are to be coupled to other cars, the cut must be stopped one car length from point of coupling before the coupling is made.

Open loads subject to shifting while being switched must not be dropped onto other cars or other cars dropped onto them; if necessary, such cars should be set to one side, then shoved to rest when classifying with other cars.

114. Flat or gondola cars, not equipped with bulkheads or gates, loaded with pipe, poles, lumber or any other type of lading which has a tendency to shift in transit should not be handled in trains next to engine, caboose or occupied work outfit cars when it can be avoided.

115. Engines, loaded placarded tank cars or other cars containing explosives, must not be stopped over open flame switch heaters unless unavoidable due to an emergency, in which case cars should be moved off promptly, or switch heaters extinguished. Conductors will advise engineers of the presence of such cars in trains.

MISSOURI-KANSAS-TEXAS RAILROAD COMPANY

101 E. MAIN STREET
DENISON, TEXAS 75020
(214) 465-5050

M. F. RISTER
ASSISTANT VICE-PRESIDENT
MECHANCIAL
D. S. KUKULL
SUPT. CARS & LOCOS.

M. D. WOODROOF
SUPT. AIR EQUIPMENT
AND DIESEL OPERATION
J. E. ROBINSON
SUPERINTENDENT CAR SHOP

Denison, Texas
January 16, 1979

5 2 3

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This will acknowledge receipt of your letter of January 3, 1979 concerning the Environmental Protection Agency broadening the scope of its railroad noise emission standards to include interstate rail carriers' equipment and facilities.

The Missouri-Kansas-Texas Railroad Company has an operating rule in effect relating to coupling speed of locomotives and cars. I am attaching copy of our rule 103(a) xeroxed from the current effective Uniform Code of Operating Rules which became effective June 2, 1968. Please notice item (2).

Yours very truly,

M. F. Rister

(1) See that cars left on tracks are properly secured, clear other tracks and, when practicable, clear public crossing at least 100 feet.

(2) When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient hand brakes. Make couplings at a speed of not more than 4 miles per hour.

(3) Before shoving yard tracks, know there is sufficient room to hold the cars. When shoving entire length of track, see that cars are coupled and, unless otherwise provided, send a man to head end to protect the movement.

(4) When necessary to control cars by hand brakes, know that sufficient brakes are in working order before cars are cut off.

(5) Kicking or dropping of cars will be permitted only when such movement can be made without danger to employes, equipment, or contents of cars. Know that the track is sufficiently clear, and when dropping cars, know switches and brakes are working properly and run engine on straight track when practicable.

Cars containing flammables, explosives, or other dangerous articles, must not be dropped or kicked.

Cars must not be dropped through spring or remote control switches.

(6) When engines may be working at both ends of a track, have proper understanding between crews involved.

(7) Before coupling to or moving cars on tracks where cars are being loaded or unloaded, see that running boards, oil tank couplings, elevator spouts and similar connections are removed and clear, and

MISSOURI PACIFIC RAILROAD CO.
210 N. 13TH STREET
ST. LOUIS, MISSOURI 63103
TEL. AREA CODE 314 622-2482

R. K. DAVIDSON
SENIOR VICE PRESIDENT—OPERATION

January 15, 1979

Q-A

Mr. H. E. Thomas, Director,
Standards & Regulations Division,
U.S. Environmental Protection Agency,
Washington, D.C. 20460

Dear Mr. Thomas:

Your letter of January 3 inquiring if Missouri Pacific has in effect an operating rule relating to locomotive and rail car coupling speed.

Section (2) of Rule 103(a) of our Uniform Code of Operating Rules governs the speed in which rail cars will be coupled. It reads as follows:

> "When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient brakes. Make couplings at a speed of not more than 4 miles per hour."

Yours very truly,

R K Davidson

THE MONONGAHELA CONNECTING RAILROAD COMPANY

3540 SECOND AVENUE

RICHARD L. McCOMBS
GENERAL SUPERINTENDENT

PITTSBURGH, PA. 15219

January 24, 1979

Mr. Henry E. Thomas, Director
Standards & Regulation Division
United States Environmental Division
Washington, D.C. 20460

Dear Sir:

I have spent some time researching old records to determine if we have ever had a published operating rule or even a bulletin which addressed the circumstances of locomotive and freight car coupling speeds. We have no such published rule or bulletin.

Ours is a short line switching railroad, with no hump yard operation in service at this time. We have a maximum operating speed limit of 10 mph. At one time we did have a hump operation including a retarder. I have discussed this operation with a number of our transportation personnel. They all agree that the understanding was that cars over the hump should not couple at speeds in excess of 4 mph, because of possible damage to lading or to equipment. This understanding still prevails as it applies to flat switching. To that extent, we have an unofficial practice in effect.

Very truly yours,

THE MONONGAHELA CONNECTING RAILROAD COMPANY

R. L. McCombs
General Superintendent

RLM:esh

cc: J. L. Hadley

NW

January 11, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This refers to your letter of January 3 requesting information concerning any Norfolk and Western operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed.

The only written provision among NW's operating Rules which relates to speed of car couplings is the following paragraph from Rule 103(h):

> "When coupling or shoving cars, proper precaution must be taken to prevent damage."

In the course of instructing NW train and engine service personnel, it is our practice to explain this requirement as prohibiting a coupling speed exceeding that of a brisk walk, or approximately four miles per hour.

Sincerely,

PEORIA AND PEKIN UNION RAILWAY COMPANY

OFFICE OF THE PRESIDENT AND GENERAL MANAGER

F. J. DUGGAN
PRESIDENT AND GENERAL MANAGER

PEORIA, ILLINOIS 61611

January 19, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This has reference to your letter of January 3, 1979, addressed in error to Mr. Spence of ConRail, the content of which is asking for a report in connection with Public Law 92-574, and which file was forwarded to me by Mr. Hesselman of ConRail, his letter of January 12, 1979.

Rule 103 (e) of the Transportation Rules of this company, revised August 1, 1977, reads as follows:

> "When coupling or switching cars, or cars are cut off in motion, coupling speed must be within safe limits not to exceed 4 MPH and proper precaution taken to prevent damage. When engines are working at both ends of a track, movements must be made carefully to avoid injury or damage."

Yours truly,

F J Duggan

THE PITTSBURGH & LAKE ERIE RAILROAD COMPANY
THE LAKE ERIE & EASTERN RAILROAD COMPANY

T. C. NETHERTON
VICE PRESIDENT-GENERAL MANAGER

PITTSBURGH, PA. 15219

January 11, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental
Protection Agency
Washington, DC 20460

Dear Sir:

Please refer to your letter to Mr. H. G. Allyn, Jr., President of the Pittsburgh & Lake Erie Railroad, dated January 3, 1979, concerning coupling speeds of cars.

Rule 130 of our Transportation Operating Rules says, "Engines and cars must be coupled at a speed not to exceed 4 miles per hour."

I trust this is what you need.

Yours truly,

T Netherton

Form 7

PORTLAND TERMINAL RAILROAD COMPANY
ROOM 209 UNION STATION
PORTLAND, OREGON 97209

January 9, 1979

File: 122-5

Mr. Henry E. Thomas, Director
Standards & Regulations Division
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Please refer to your letter dated January 3, 1978, addressed to Mr. T. C. DeButts, President, Portland Terminal Railroad Company, in which it was asked if our Company has in effect an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed, has been referred to the undersigned for reply.

Enclosed is a copy of Manager's Instruction Bulletin No. 27 which is dated January 1, 1979, which is an annual reissued bulletin regarding coupling speed. The original instruction bulletin was issued several years ago and, as indicated above, is reissued annually.

It should also be noted that each switch list form is printed with the following information:

"Safe Coupling Speed not more than 4 M.P.H."

It is hoped that this is the information you have requested.

Very truly yours,

EK Strong
Manager

Enclosure

PORT TERMINAL RAILROAD ASSOCIATION
P. O. BOX 9504, HOUSTON, TEXAS 77011

T. E. WIMBERLY
GENERAL MANAGER

January 10, 1979

Mr. H. E. Thomas, Director
Standards and Regulations Division (ANR-490)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

Reference yours of Jan. 3, 1979 concerning railroad noise emission standards and rules or practices governing coupling impact speeds.

PTRA does have such a rule (70 (e)) governing and copy is attached hereto as per your request.

Yours truly,

T. E. Wimberly

T. E. Wimberly
General Manager

Attach.

H-109

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best available copy.

This book is the property
of the
**PORT TERMINAL RAILROAD
ASSOCIATION**
and is loaned to

NAME	OCCUPATION	DATE ISSUED

who hereby agrees to return it to the proper official when called for, or upon leaving the service.

PORT TERMINAL RAILROAD ASSOCIATION

▲

Rules and Regulations

Effective May 1, 1947
Revised February 1, 1957

~

The rules herein set forth govern the employes of the Port Terminal Railroad Association, and employes of the railroads using the property and facilities of this Association. They supersede all previous rules and instructions inconsistent therewith.

Special instruction may be issued by the proper authority.

C. E. Bullock,
General Manager

made carefully and with an understanding to avoid injuries or damage.

(d) Before shoving cars on tracks, it must be known there is sufficient room in the track to hold all of the cars. When shoving entire length of track, see that cars are coupled and unless otherwise provided, send a man to end of cut to protect the movement.

(e) When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient hand brakes. Make couplings at a speed of not more than four miles per hour.

(f) Cars containing livestock must not be kicked or dropped or other cars kicked or dropped against them.

(g) Warning or commodity cards must be observed and their instructions complied with. Yardmasters and yardmen must familiarize themselves with the Bureau of Explosives instructions governing the handling of explosives, inflammables and acids, or other dangerous articles.

Cars will be dropped only when necessary, and when practicable engine must be kept on the straight track. Before making a drop, stop must be made, brakes and switch tested.

71. Cars must be left with sufficient hand brakes set, after the air is released from auxiliary reservoir, to prevent moving. Cars with defective hand brakes must be securely blocked and, when possible, coupled to cars having serviceable hand brakes. In switching, cars must not be stopped or retarded through use of blocks or chocks.

72. Cars must be left clear of any street or public crossing, and at least one hundred feet from the crossing when practicable, and must not be so left as to obstruct view of approaching cars or engines by the public.

73. It must be known that engines or cars standing on parallel or industry tracks are clear of main track and that nothing protrudes therefrom.

74. Employes must control or stop cars by hand brakes when necessary.

75. Engine foremen will report to car inspectors any defects observed on cars being handled or in yard.

76. In case of extraordinary rain storm or high water, engines and cars must be stopped, and bridges, trestles, culverts or other points subject to damage, examined by competent employe to ascertain if safe before proceeding.

If track or structure has been damaged and which may cause an accident, the condition must promptly be reported to proper officer, and if necessary a flagman must be left to protect other

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RF&P

RICHMOND, FREDERICKSBURG AND POTOMAC RAILROAD COMPANY
2134 WEST LABURNUM AVENUE RICHMOND, VIRGINIA 23227
TELEPHONE (804) 257-3221

STUART SHUMATE
President

January 12, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

This will acknowledge your letter of January 3, 1979 regarding noise emission standards applicable to interstate rail carriers' equipment and facilities.

We do not have an operating rule in effect at our Acca Yard (Richmond, Virginia) facility or on-line of road which publishes a specific coupling speed for locomotives or cars. In practice, we encourage the industry standard of coupling speeds not in excess of four miles per hour or speeds not exceeding a "brisk walk". This practice is promoted during training of new employees and other training sessions as well as in the continuing personal contact and instructions by supervisory personnel.

At the Potomac Yard (Alexandria, Virginia) facility, the Special Instructions do contain rules relating to coupling speeds. This facility is, as you are no doubt aware, a hump yard and coupling conditions include many variables. The instructions, depending upon circumstances involved, refer to use of good judgment, retarder exit speeds and a flat switching speed not to exceed four miles per hour.

As you requested, an example of each of these rules is attached and we trust this will supply the information desired.

Sincerely,

Stuart Shumate
President

ADDITIONAL RESPONSIBILITIES OF CAR RETARDER OPERATOR

1. Car retarder operators must stay in close proximity to their control machine unless they have received permission to do otherwise.
2. Car retarder operators are responsible to verify car initials and numbers on the cutslip and observe movements into proper classification tracks.
3. He must constantly monitor the model board and keep all undesired information (bugs) cleared in the system. He must utilize the warning lights to assist in locating close clearance or cars fouling adjacent tracks in the classification yard in order to avoid sideswipes or cornering cars undergoing classification.
4. He must be alert to prevent catch-ups, derailments or cornering, and when necessary will override automatic switching or stop cars to prevent these occurrences.
5. He is responsible to inform the hump conductor of conditions in the classification yard which need attention or which will affect the normal operations. He must be particularly alert to tracks that need shoving and cars not in proper classification.
6. He must have a complete understanding with the conductor on movements to be made from the hump ends of the classification yards. He is responsible to line routes for all movements from classification yard toward the hump, put the retarders in the "off" position, inform the hump conductor of clear route, and observe movement.
7. The car retarder operator on the southward hump will select proper speeds for car to exit from the group retarder based on the weight indication that registers on the weight indicator on the model board, weather conditions, the distance to travel and the knowledge of whether the car is protected by a single skate or the minimum number of hand brakes. In any case, he should utilize his experience and any information available to him to exercise good

judgment in the selection of speeds.

8. **Car retarder operators on northward hump must keep the car retarders in fully automatic mode of operation while cars are undergoing classification, except when safety of operation, efficiency of operation, or specific instructions noted elsewhere in this book require otherwise. (That is, long tank cars, cabooses, extra heavy cars, or multiple cuts of heavy cars.)**
9. **Car retarder operator on northward hump must have proper understanding with hump conductor on mode to be used when it is known that cars are to be cut off on the hump.**

load, including the location of and prevailing conditions in the track in which it is to be classified.

A single load with an overhang on one or both ends, with idlers, must not be allowed to move into any track in either classification yard where there is a possibility of the overhang coming in contact with a car or fixed structure. Special attention must be given to moves of this kind, keeping in mind sharp curves, locations of other cars in track, etc.

In no case should triple loads or loads with an overhang be allowed to move to or from the north end of No. 39 track in the southbound classification yard. Loads of this type must not be forwarded in outbound trains until all current instructions relating to clearances and measurements of the respective tenant lines have been complied with.

(11) On both the northward and southward humps, when classifying heavy cars in excess of ninety (90) tons in multiple cuts, the cut lengths will be limited to no more than four (4) cars, unless the cut is ten (10) or more cars, in which case they may be classified in multiple.

On the southward hump, when classifying multiple cuts of extra heavy cars, the exit speed selected must not be in excess of five (5) miles per hour.

(12) When classifying exceptionally long tank cars over the northward hump, no selection should be made by the hump conductor for a following route until each exceptionally long tank car is north of the master retarders and the route selection for that tank car has disappeared.

(13) The circuits on the tracks into the southward classification yard from the hump are not designated to handle cars in excess of 75 feet. In all cases where long cars (in excess of 75 feet) are to be classified, the following procedure must be adhered to:

1. A route selection should be punched by the hump conductor for the long car and no additional selection punched until the long car is south of the master retarders.
2. The hump conductor must control the humping so that a following cut is not cut off until the long car has cleared the master retarders.

inspectors must see that doors on all empty cars are securely fastened before trains leave Terminal.

(14) Handling occupied cabin cars while humping train or kicking occupied cabin cars is prohibited.

(15) Dual control switches will not be thrown by any other means than the lever attached to the machine for the purpose of manually operating the switch.

The practice of punching these switches over by opening the covers and manipulating the valves is not authorized and furthermore, is extremely dangerous in that it sets up the probability of a derailment for the next crew approaching the switch, and it can result in a personal injury to the individual manipulating the switch.

(16) Trailing point movements must not be made through either electrically controlled or dual controlled yard switches until they have been properly aligned or on specific instructions from the Assistant to Trainmaster at Desk 223, and upon receiving such instructions, movement will only be made after a member of the crew has established that there are no obstructions in the switch points and no obvious defects with the switch.

(17) In flat switching, trainmen must at all times protect movement so as to avoid personal injury, damage to equipment and lading.

Engines and cars must be coupled at a speed not to exceed four (4) miles per hour.

(18) In an effort to prevent potential accidents, yard trainmen are requested to endeavor to make certain all plug type doors on box cars are closed and secured prior to making movement.

(19) Employees are prohibited from riding the sides or tops of engines or cars while moving through the enginehouse sanding facilities located between the B&O motor storage track and the Penn Central motor storage tracks No. 2 and No. 3.

(20) The old No. 1 Shore Track (the stub-end track leading off the turntable adjacent to and on the west side of the roundhouse) is used to store covered hoppers containing sand for the sanding towers.

THE ROCK

January 22, 1979

Mr. H. E. Thomas, Director
Standards & Regulations Division(ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Please refer to your letter of January 3, 1979 concerning noise generated in railroad yard operations.

The Rock Island uses the "Uniform Code of Operating Rules" to control its train operations. Rule 103(#2) of these Rules states:

"When coupling or shoving cars, take proper precaution to prevent damage or fouling of other tracks by stretching coupling, and setting sufficient hand brakes. Make couplings at speed of not more than four MPH."

I hope this information will fill your needs. If you have any further need for information, please let me know.

J K Beatty
J. K. Beatty
Director Rules-Safety

ef

FRISCO

ST. LOUIS-SAN FRANCISCO RAILWAY COMPANY
906 Olive Street — St. Louis, Missouri 63101 — (314) 241-7800

EORGE E. BAILEY
General Solicitor

ONAL L. TURKAL
RIC A. CUNNINGHAM, JR.
Associate General Counsel

ERALD D. MORRIS
ONALD E. RANSOM
Assistant General Counsel

DONALD E. ENGLE
Vice President and General Counsel

DENNIS T. RATHMANN
GERALD J. HARVATH
General Attorneys

ANDREW F. REARDON
THOMAS H. MUG
Attorneys

January 17, 1979

85875-C

Mr. Henry E. Thomas, Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, DC 20460

Dear Mr. Thomas:

This is in reply to your letter of January 3, 1979, requesting information regarding operating rules, operating practices, or recommended practices relating to locomotive and rail car coupling speed.

Please be advised that St. Louis-San Francisco Railway Company has no formal operating rule or written practice regarding coupling speed. As a recommended practice, Frisco does follow the A.A.R. recommendation of 4 miles per hour coupling speed in order to minimize damage to equipment and lading. However, Frisco does consider coupling speeds up to 6 miles per hour to be safe.

You have indicated that it is your intention to use this information in the establishment of railroad yard noise emission standards. It is our opinion that coupling speed will have only a slight effect on overall yard noise, and that to adopt a recommended operating practice as a noise guideline without serious study could be a mistake.

If I may be of further assistance, please advise.

Very truly yours,

Thomas H Mug

Thomas H. Mug

THM:smn

The Atchison, Topeka and Santa Fe Railway Company
A Santa Fe Industries Company
80 East Jackson Boulevard, Chicago, Illinois 60604, Telephone 312/427-4900

January 18, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental
Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

Please refer to your letter dated January 3, 1979, sent certified mail, requesting copy of Santa Fe's operating rule relating to locomotive and rail car coupling speeds.

Rule 112(c) of Rules - Operating Department, The Atchison, Topeka and Santa Fe Railway Company, effective January 5, 1975, and currently in effect, reads:

> "Before coupling to or moving cars or engines it must be known that they are properly secured and can be coupled to and moved safely. Cars and engines must not be permitted to couple at a speed in excess of four miles per hour. Unless previous inspection has been made, cars picked up must be inspected and determined that they are in condition to be handled."

Very truly yours,

L. Cena
President

The Atchison, Topeka and Santa Fe Railway Company
A Santa Fe Industries Company
80 East Jackson Boulevard, Chicago, Illinois 60604, Telephone 312/427-4900

January 25, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

Please refer to your request of January 3, apparently addressed to railroad presidents. I have just received a copy of a reply from Mr. L. Cena, President of Santa Fe Railway, in which he quotes one of our operating rules regarding coupling speed. I am somewhat surprised you did not request this information from the AAR representatives who have been working with you and your staff on noise regulations.

I am sure you realize that while ideal coupling speeds may be 4 m.p.h., the rule was not issued with noise consequences in mind. Careful handling of lading is an important program on Santa Fe, however minor variations in coupling speed are not unknown. They have little effect on potential damage to lading. Similarly, slight variations in this coupling speed have no discernible effect on the noise levels produced by coupling.

One rather obvious objection to an attempt to relate coupling speeds to noise regulations is that attempts to differentiate noise produced by couplings at 4 m.p.h., as opposed to perhaps 5 or 6 m.p.h., appears to be an extremely difficult task.

If you intend to consider this matter further, you may wish to contact the AAR Environmental Staff which may be able to assist you in your efforts to obtain meaningful data.

Very truly yours,

John C. Palmer, Jr.
General Attorney

JCP/jmw

cc: Mr. L. Cena
Hollis Duensing, Esq. AAR

SEABOARD COAST LINE RAILROAD COMPANY

Law Department
500 Water Street
Jacksonville, Florida 32202

JOHN W. WELDON
VICE PRESIDENT – LAW

AREA CODE 904
353-2011, EXT. 246

January 18, 1978

IN REPLY PLEASE REFER TO FILE

LEGAL: Legislation
US: Pollution
Noise

Mr. Henry E. Thomas
Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This letter is written in response to your request of January 3 addressed to Prime F. Osborn. Mr. Osborn asked that I furnish you with the desired information.

Enclosed is a copy of SCL Operating Rule 103-D. It prohibits couplings at speeds in excess of 4 miles per hour.

If further information is desired by the EPA, please do not hesitate to contact me.

Cordially,

John W. Weldon

John W. Weldon

CC:

Mr. Prime F. Osborn

flag protection has been afforded. At railroad crossings protected by interlockings, such cars must stop clear of the crossing and must not proceed over the crossings until proper protection has been afforded.

103. In, switching, employees must observe the position of engines or cars on other tracks and must know that such engines or cars are in the clear before permitting engine or cars to move past them.

103-A. Cars and engines left on tracks must be properly secured, clear of insulated joints, and clear of other tracks where conditions permit; and when practicable, cars and engines should be left at least 100 feet from a public crossing.

103-B. Employees leaving cars in a track must set sufficient hand brakes to prevent them from rolling away when other cars are dropped or kicked against them. When additional cars are placed in the track, sufficient additional hand brakes must be set.

103-C. When practicable, cars will not be uncoupled on curves or in switches. When necessary to couple to cars on curves or in switches, it must be known that couplers match and coupling speed must be controlled to avoid jackknifing. Special care must be given when coupling cushion underframe or long cars.

103-D. When coupling or shoving cars, precautions must be taken to prevent accidental fouling of other tracks, public crossings and derails, and to avoid runaway cars.

Before coupling to cars or engines standing near end of tracks, derails, public crossings, or cars in process of loading or unloading, it must be known that they are secured and will not roll away and cause damage in event coupling is missed. Couplings should not be made at speed greater than four miles per hour. When conditions require, before shoving cars, it must be known by stretching the couplings that all couplings are made.

Soo Line Railroad Company

SOO

Soo Line Building
Box 530
Minneapolis, Minnesota 55440
(612) 332-1261

GILBERT A. GILLETTE
Assistant Vice President
Operations-Planning

January 15, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your January 3, 1979 letter addressed to Mr. L. L. Wasnick, wherein you discussed railroad noise emission standards as they relate to coupling speeds, has been referred to me for reply.

Editorially, it is our experience that factors such as the type of car and nature of load (empty covered hopper cars tend to have a "drum" effect, even at low coupling speeds), atmospheric conditions and the direction of the wind have as much or more contribution to noise annoyance as coupling speed alone. Also, it has been our experience that under certain conditions, slack adjustment in coupled trains (from buff to draft and back again) can cause complaints of noise.

Nonetheless, Soo Line has had for many years mandatory instructions governing proper coupling speeds (not to exceed 4 M.P.H.). Railroad mandatory operating instructions are commonly issued in the following forms on the Soo Line:

1. The Consolidated Code of Operating Rules (1967), mandatory rules.

2. Time Tables for each division, including a set of mandatory special instructions for each division.

3. General Orders, for mandatory instruction of crews with regard to operating conditions of a temporary nature but of a month, or more duration; also, for changes to the Consolidated Code, time tables or special instructions pending reprinting.

4. Train Orders for mandatory orders on a daily or short range basis.

Soo Line has incorporated its mandatory coupling speed instructions in each of its divisional special instructions and believes this is the proper format for these instructions.

Attached are copies of:

1. SIE-6, Special Instructions for the eastern division;
2. SIC-6, Special Instructions for the central division;
3. SIW-3, Special Instructions for the western division.

In each case, the cover sheet is included for identification purposes and the page containing the coupling speed instructions is shown to the right of the cover sheet.

Yours truly,

G. A. Gillette

GAG:csk
Attachments

SOO LINE RAILROAD COMPANY

WESTERN DIVISION

SPECIAL INSTRUCTIONS and SPEED RESTRICTIONS

NO.

SIW-3

EFFECTIVE 12:01 A.M.
CENTRAL STANDARD TIME
Sunday, December 1, 1974

For the government and
information of employees only.

D. F. KEMMER — Superintendent
H. A. PETERSON — Director Transportation Operations
D.M. CAVANAUGH — General Superintendent
T. R. KLINGEL — Executive Vice President

JUDGING SPEED

Accurate judgment of coupling speed depends upon correct timing. An excellent way to get accurate timing without a watch is to count "one hundred and thirty-one, one hundred and thirty-two" and so on as the car passes a stationary point. With a little practice counting can be done at the rate of one a second.

Ability to closely estimate speed at time car strikes is extremely important because impact force builds up as the square of the speed. This means that impact delivered by a car coupled at 8 miles per hour is not four times that at 2 miles per hour, but 16 TIMES AS GREAT. Damage to freight or car can be avoided by always keeping coupling speed within the safe range — NOT OVER 4 MILES PER HOUR — A BRISK WALK.

IMPACT FORCE AT VARIOUS STRIKING SPEEDS

	Car Coupled at	Units of Destructive Force
Safe	1 mph	1
	2 mph	4
	3 mph	9
	4 mph	16
Damaging	5 mph	25
	6 mph	36
	7 mph	49
	8 mph	64
	9 mph	81
	10 mph	100

SPEED CARD

To Find Coupling Speed of 40 Foot and 50 Foot Car

Sight vertical end of car body on a fixed point and note the number of seconds it takes car to pass. Speed in miles per hour is shown opposite.

Damage as a result of Rough Handling makes up a large part of the claim bill for Loss and Damage to Freight. From the Railroad standpoint it is the major item in the expense. We all know that Rough Handling can be reduced, often eliminated. It is hoped that this card will be helpful in your efforts to prevent Rough Handling.

Switch Crews must function as a team. Clear signals properly given are mighty important; talk it over — prevent Rough Handling — it can be done.

Seconds	40 Foot Car Miles Per Hour	50 Foot Car Miles Per Hour
1	28	35
2	14	17.5
3	9.3	11.6
4	7	8.7
5	5.6	7
6	4.7	5.9
7	4	5
8	3.5	4.4
9	3.1	3.9
10	2.8	3.5
11	2.5	3.1
12	2.3	2.9
13	2.15	2.7
14	2	2.5

Reproduced from best available copy.

SOO LINE RAILROAD COMPANY

CENTRAL DIVISION

SPECIAL INSTRUCTIONS and SPEED RESTRICTIONS

NO. SIC-6

EFFECTIVE 12:01 AM
CENTRAL STANDARD TIME
SUNDAY, FEBRUARY 1, 1976

For the government and information of employees only.

C. C. LEARY — Superintendent
J. D. DARLING — Director of Transportation-Operations
D. M. CAVANAUGH — General Superintendent
T. R. KLINGEL — Executive Vice President

JUDGING SPEED

Accurate judgment of coupling speed depends upon correct timing. An excellent way to get accurate timing without a watch is to count "one hundred and thirty-one, one hundred thirty-two" and so on as the car passes a stationary point. With a little practice counting can be done at the rate of one a second.

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	7 mph	49
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Switch Crews must function as a team. Clear signals properly given are mighty important; talk it over — prevent Rough Handling — it can be done.

SOO LINE RAILROAD COMPANY

EASTERN DIVISION

SPECIAL INSTRUCTIONS and SPEED RESTRICTIONS

NO. SIE-6

EFFECTIVE 12:01 A.M.
CENTRAL STANDARD TIME,
SUNDAY, JANUARY 22, 1978

For the government and information of employees only.

H.W. ELLEFSON, Superintendent
A.W. DURTSCHE, Director of Transportation Operations
C.C. LEARY, General Superintendent
D. M. CAVANAUGH, General Manager-Transportation & Maintenance

JUDGING SPEED

Accurate judgment of coupling speed depends upon correc timing. An excellent way to get accurate timing without watch is to count "one hundred and thirty-one, one hundre and thirty-two" and so on as the car passes a stationary point With a little practice counting can be done at the rate of on a second.

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IMPACT FORCE AT VAHIOUS STRIKING SPEEDS

	Car Coupled at	Units of Destructive Force
Safe	1 mph	1
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SPEED CARD

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12	2.3	2.9
13	2.15	2.7
14	2	2.5

Southern Pacific
Transportation Company
Southern Pacific Building • One Market Plaza • San Francisco, California 94105

D. K. McNEAR
PRESIDENT

January 17, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection
  Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Referring to your letter January 3 concerning the EPA broadening the scope of its railroad noise emission standards to include interstate rail carriers' equipment and facilities.

With respect to your request for information concerning coupling speeds, wish to advise that on Southern Pacific Transportation Company, St. Louis Southwestern Railway Company and all subsidiary Company property, the recommended coupling speeds are not to exceed 4 MPH. This is the recognized industry standard that has been in effect for many years. Your information is correct that this standard was established primarily to minimize damage to lading and equipment.

In addition, part of Rule 837 of the Rules and Regulations of the Transportation Department reads as follows:

> "Switching must be carefully done, and trains and engines must be carefully handled, to avoid shocks from abrupt starting or stopping; from impact in making coupling, and to prevent personal injuries, and damage to equipment or contents."

Yours very truly,

DK McNear

Southern Railway System

P.O. Box 1808
Washington, D.C. 20013

L. STANLEY CRANE
PRESIDENT

920 15TH STREET, N.W.
TEL: (202) 628-4460

January 12, 1979

Mr. Henry E. Thomas
Director
Standards and Regulations Division
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

This replies to your letter of January 3, 1979, asking if Southern has an operating rule, operating practice or recommended practice relating to locomotive and rail car coupling speed.

It is our practice to try to keep the coupling speed to 4 miles per hour or less. However, it is not always possible to do so, and coupling can take place at slightly higher speeds with no adverse effect on the equipment or lading. We have no operating rule setting a limit on coupling speed, nor is this practice reflected in any written document.

In your letter, you state that you have information that rail car coupling speed can be a factor in the total noise level of a railroad yard. In our view, while coupling speeds could theoretically have some small effect on the noise level, in practice it is unlikely that the restriction of all coupling speeds to 4 m.p.h. or less would have a significant effect on the level of yard noise.

Yours sincerely,

L. Stanley Crane

cc: Mr. William H. Dempsey, AAR
Mr. Hollis G. Duensing, AAR

Southern Railway System

Law Department
P.O. Box 1808
Washington, D.C. 20013

JAMES L. TAPLEY
VICE PRESIDENT - LAW

920 15TH STREET, N.W.
TEL: (202) 628-4460

February 26, 1979 pcc
58057

Mr. Henry E. Thomas
Director
Standards and Regulations Division (ANR-490)
U. S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Please refer to your letter of February 9, 1979 to Mr. H. W. Hobson, asking if The Cincinnati, New Orleans & Texas Pacific Railway Company (CNO&TP) has an operating rule, operating practice, or recommended practice relating to locomotive and rail coupling speed.

The CNO&TP is a subsidiary of Southern Railway Company and a member of Southern Railway System. Mr. L. Stanley Crane is the President of both companies. On January 12, 1979, Mr. Crane wrote in response to your letter of January 3, 1979, replying on behalf of Southern to the same question asked again in your letter of February 9 to Mr. Hobson. The answer on behalf of the CNO&TP is the same as that given on behalf of Southern in Mr. Crane's letter of January 12, 1979. A copy of Mr. Crane's letter is attached for your ready reference. We did not make a separate reply on behalf of the CNO&TP because our reply for Southern serves for all of the carriers which are members of the Southern Railway System.

Yours sincerely,

James L. Tapley

James L. Tapley
Vice President - Law

Att.

cc: Mr. William H. Dempsey, AAR
Mr. Hollis G. Duensing, AAR
Mr. H. W. Hobson

TERMINAL RAILROAD ASSOCIATION OF ST. LOUIS

L. JEFF KING
PRESIDENT

906 OLIVE STREET
ST. LOUIS, MO. 63101

February 21, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Sir:

Please refer to your letter of January 3, 1979, and follow-up of February 9, addressed to "Mr. L. K. Press," in connection with the noise level of railroad yard operations. There was some uncertainty as to the person for whom your letter was intended.

Operating forces of Terminal Railroad Association have, over the years, recognized that impacts in excess of 4 mph contribute to lading damage, and while we do not presently have such a rule in our Book of Operating Rules, consideration is being given to covering the subject by a General Order for the future.

Yours very truly,

LJKing

L. J. King

LJK:gca

THE TEXAS MEXICAN RAILWAY COMPANY
P. O. BOX 419
LAREDO, TEXAS 78040

A. R. RAMOS
PRESIDENT

TEL. NO. (512) 722-6411
TELEX NO. 76-34-11

January 12, 1979

077

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

Reference is made to your letter dated January 3, 1979, addressed to former President, Mr. B. F. Wright, Jr., regarding the Environmental Protection Agency railroad noise emission standards.

In answer to your question regarding an operating rule, operating procedures, or recommended practice relating to locomotive and rail car coupling speed, I am attaching herewith a copy of our Rule No. 837 of The Texas Mexican Railway Company's Rules and Regulations of the Transportation Department.

While the rule does not specifically state the speed at which cars must be coupled, it has been the operating procedure on this Railroad that coupling speed must not exceed 4 m.p.h. To fully comply with the Federal government, we are in the process of amending Rule 837 to include the speed limit restriction.

Yours very truly,

A. R. Ramos

ARR:ssw

837. Switching must be carefully done, and trains must be carefully handled, to avoid shocks from abrupt starting or stopping of cars, or from impact in making coupling, and to prevent damage to cars or contents.

Before fouling any track, it must be known that engines or cars on adjacent tracks will clear.

Before shoving cars into spur tracks, any cars standing on the spur must be properly secured by setting hand brakes, irrespective of grade conditions, before coupling or shove is attempted.

Cars must not be shoved or coupled without a definite knowledge that lead or adjacent tracks will not be fouled.

Cars standing on grade must not be coupled onto, in descending direction, without knowing sufficient hand brakes are set to prevent uncontrolled movement of any such cars, should coupling fail or cars not be securely coupled.

Before beginning to shove cars, they must be stretched to insure that all cars are properly coupled.

Occupied outfit equipment must not be switched unless air brakes are in service on all cars, and must not be detached while in motion, nor other cars kicked or dropped against them. When making coupling to such cars, air brakes must be cut in and operative on all cars being handled.

TOLEDO, PEORIA & WESTERN RAILROAD COMPANY

2000 EAST WASHINGTON STREET • EAST PEORIA, ILLINOIS 61611
PHONE 309-699-3941

January 15, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR 490)
United States Environmental Protection Agency
Washington D. C. 20460

Dear Mr. Thomas:

In answer to yours of January 3, 1979, the Toledo, Peoria and Western Railroad Company had published in its Timetable No. 1, that was in effect from May 20, 1973 until December 30, 1978, to be observed by its operating personnel as a recommended practice, the enclosed instruction.

Since Timetable No. 1 was superseded December 31, 1978 by Timetable No. 2, similar instructions were issued to operating employees in Bulletin form (copy of Bulletin No. 251 enclosed).

Yours truly,

AWPolich

A. W. POLICH
Vice President-Operations

JRB:AWP:baa
Enclosure.

TOLEDO, PEORIA AND WESTERN RAILROAD COMPANY

East Peoria, Illinois

January 15, 1979

BULLETIN NO. 251

ALL CONCERNED:

While switching coupling speed in excess of 4 MPH is prohibited.

A SAFE COUPLING SPEED IS	4 MPH
DAMAGE BEGINS AT	5 MPH
2¼ times more damaging	6 MPH
4 times more damaging	8 MPH

DON'T LET DAMAGE BEGIN, ALWAYS KEEP COUPLING SPEED WITHIN SAFE RANGE - NOT OVER 4 MILES PER HOUR - A BRISK WALK.

SWITCH CARS CAREFULLY

J. R. Brown

J. R. BROWN
Assistant Superintendent

AVOID DAMAGE

SWITCH CARS CAREFULLY

SAFE COUPLING SPEED IS ....4 miles per hour
DAMAGE BEGINS AT ....5 miles per hour
2½ times more damaging ....6 miles per hour
4 times more damaging ....8 miles per hour

DON'T LET DAMAGE BEGIN, ALWAYS KEEP COUPLING SPEED WITHIN SAFE RANGE — NOT OVER 4 MILES PER HOUR—A BRISK WALK.

SWITCH CARS CAREFULLY

UNION PACIFIC RAILROAD COMPANY
OPERATING DEPARTMENT

A. D. WILLIAMS
DIRECTOR ENERGY AND ENVIRONMENTAL
PROGRAMS-PLANNING

1416 DODGE STREET
OMAHA, NEBRASKA 68179

January 19, 1979

500-552-Research

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

In reply to your letters of January 3, 1979, to Mr. R. L. Richmond and Mr. D. Catalan inquiring as to whether the Union Pacific has in effect an Operating rule or practice relating to locomotive and rail car coupling speed:

The Union Pacific does not include in its general rule pertaining to switching any specific maximum coupling speed. Our switchmen/trainmen are instructed through the use of the enclosed publication from the AAR which does specify a 4 MPH maximum recommended coupling speed.

Trust this answers your question, but should you need any further information, feel free to call on me.

Yours truly,

A. D. Williams

A. D. WILLIAMS

UNION RAILROAD COMPANY

GENERAL OFFICES 600 GRANT STREET
POST OFFICE BOX 536

M. SPALDING TOON
PRESIDENT

PITTSBURGH, PA. 15230

January 12, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

This is in response to your letter of January 3 requesting information relating to locomotive and rail car couplings.

Industrial switching is placing cars for loading and unloading at various industries. Couplings are made at slow speeds with the engine attached and at speeds of no more than three to four miles per hour.

Classification yard switching is usually for line haul movement and consists of a series of tracks with each one designated for a different destination. Cars are allowed to move onto these tracks detached from the locomotive and couple to other cars already on the tracks at speeds averaging five to six miles per hour. Empty cars are even permitted to couple to other cars at speeds up to seven and eight miles per hour and do so without damage.

We do not have an operating rule specifying coupling speeds, but as a matter of practice, the speeds under these two types of switching are as stated above.

Yours very truly,

President

The Washington Terminal Company

UNION STATION • WASHINGTON, D. C. 20002

C. W. Shaw, Jr.
Manager

January 11, 1979

Mr. Henry E. Thomas, Director
Standards and Regulations
Division (ANR-490)
United States Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Thomas:

Your letter of January 3rd to Mr. A. M. Schofield regarding railroad operating rules governing coupling speeds has been referred to me.

Rule 96, Rules and Regulations of The Washington Terminal Company reads as follows: "Before coupling cars, safety stop will be made approximately five feet from the cars to be coupled to avoid rough coupling. When switching, engine or cars will not be detached until MOVEMENT is stopped......" Therefore, on Washington Terminal property, coupling speeds are considerably less than four (4) miles per hour.

Yours very truly,

C. W. Shaw, Jr.

THE WESTERN PACIFIC RAILROAD COMPANY
SACRAMENTO NORTHERN RAILWAY
TIDEWATER SOUTHERN RAILWAY CO.

WESTERN PACIFIC BUILDING. 526 MISSION STREET
SAN FRANCISCO. CALIFORNIA 94105

TELEPHONE 982-2100

January 9, 1979

File: 076

Mr. Henry E. Thomas, Director
Standards and Regulations Division (ANR-490)
United States Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Thomas:

This is in response to your January 3, 1979 letter requesting information regarding recommended coupling speeds on Western Pacific.

Attached is copy of Rules 103 and 103-A pertaining to coupling.

Also attached is copy of Page 56 and the inside back cover of our current operating timetable setting forth the safe coupling speed.

Very truly yours,

C. G. YUND, Chief Engineer

Enc.

By
J. C. Miller

When in doubt as to the wisdom of proceeding, train must be moved if safety will permit, to the safest available place and there held until determined that it can proceed with safety. The train dispatcher must be kept informed of conditions from nearest available point of communication.

Detectors that check for defects do not relieve employees of making required visual inspections.

101-D. (T) During and immediately following stormy weather which may impair the roadway, engineers must take extraordinary precautions to insure safe movement of their train, reducing speed where in their judgment it may be required.

Where normal visibility is impaired, trainmen and enginemen must take extraordinary precautions to operate their trains safely.

102. (T) When a train is disabled or makes an emergency stop, radio communication must immediately be used to stop trains on any adjacent track. Also, such tracks must immediately be protected by flag until it is ascertained there is no obstruction and that they are safe for passage of trains. The train must be inspected before it is moved. When a train air brake system goes into emergency application and the cause is not known, no movement will be made until hand, lamp, or radio signal is given.

102-A. (T) When for any reason an engine leaves its train or part of its train on the main track, a sufficient number of hand brakes must be set to keep train from moving. When safety requires, torpedoes must be placed a sufficient distance ahead of the standing equipment to serve as a warning and a crew member must protect the returning movement.

103. (T) When shoving cars, precaution must be taken to prevent damage or fouling other tracks. When conditions require, a member of the crew must take a conspicuous position on the leading car, with the proper signals. When shoving cars over crossings not protected by crossing gates in lowered position, a trainman must ride the leading end or be ahead to protect the crossing. When kicking or dropping cars over crossings not protected by crossing gates in lowered position, a member of the crew must protect the crossing.

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103-A. (T) Switching must be done in a careful manner to avoid severe shocks by sudden starting or stopping or by impact in making couplings and to prevent personal injury, damage to equipment or lading.

Kicking or dropping of cars must be done in a careful manner to avoid injuries and damage. Such movements must not be made with cars placarded "Explosives" or "Dangerous" with cars occupied by persons or livestock, or to tracks occupied by such cars. Loaded T.O.F.C. or multilevel cars must not be kicked or dropped against other cars nor other cars against them.

Tank cars containing Flammable Compressed Gas (FCG) shall not be cut off when in motion. No car moving under its own momentum shall be allowed to couple to a car containing Flammable Compressed Gas (FCG).

Before making a drop it must be determined that there is adequate room and that hand brakes and switches to be used are in working order. Engine must be run on straight track when practicable.

When cars are cut off to an open track, precautions must be taken to prevent fouling other tracks. When necessary to control cars by hand brakes it must be known, before cars are cut off, that such brakes are in good order.

Cars must not be shoved or kicked or left to foul leads or adjacent tracks until it is known that it is safe to do so. Engines and cars must not be left to foul adjacent track if possible to avoid it.

H-140

ASSISTANT AND RELIEF CHIEF DISPATCHERS

J. E. Taylor
E. L. Nielson
J. P. Wirick

W. J. Goolsby
D. F. Meyer
R. C. Ditmanson

TRAIN DISPATCHERS

R. M. Beard, Jr.
R. A. Ditmanson
D. D. Bradford
J. C. McCall
M. E. Edgeman
C. L. Foss
P. C. Sanchez
A. Kinicki
C. T. Mallory
J. M. Baird

J. R. Summers
R. G. Cotton
A. G. Mendoza
G. Wigley, Jr.
M. G. Lusk
G. M. Arnoldsen
K. F. Arnoldsen
A. R. Mize
W. B. Robblee

WATCH INSPECTORS

Location	Name	Title
land	Allphin Jewelers	Watch Inspector
land	Leslies Jewelry	Watch Inspector
Jose	Frank Scholes	Watch Inspector
kton	W. K. Bank & Son	Watch Inspector
lesto	W. P. Shoemake's	Watch Inspector
mont	Easley Jewelry	Watch Inspector
umento	Grebitus & Son	Watch Inspector
eville	Martin's Jewelers	Watch Inspector
ville	Chuck's Time Shop	Watch Inspector
sey	Rollo Jewelers	Watch Inspector
nemucca	Dan Ramasco	Watch Inspector
	Blohm Jewelers	Watch Inspector
Lake City	H. B. Miller Co.	Watch Inspector
Lake City	Burrell Jewelry	Watch Inspector

AVOID DAMAGE—SWITCH CUSTOMERS' CARS CAREFULLY

OVERSPEED Couplings are **DAMAGING—Here's what happens:**

iles per hour ☐	**SAFE COUPLING SPEED**
iles per hour ☐	Damage begins
iles per hour ☐	2½ times as damaging as 4 MPH
iles per hour ☐	3 times as damaging as 4 MPH
iles per hour ☐	4 times as damaging as 4 MPH
iles per hour ☐	5 times as damaging as 4 MPH
iles per hour ☐	6 times as damaging as 4 MPH

Damage to freight or car can be avoided by always keep coupling speed within the safe range — NOT OVER 4 ES PER HOUR—A BRISK WALK.

HANDLE FREIGHT CAREFULLY AND
KEEP OUR CUSTOMERS!

ALL SUBDIVISIONS

RULE 1137 (T). Use of retaining valves.

When locomotive will control speed of train and total brake pipe reduction does not exceed 18 pounds, or if dynamic brake becomes inoperative and total brake pipe reduction does not exceed 18 pounds, the use of retainers will not be required.

Between the following points, if total brake pipe reduction exceeds 18 pounds, stop must be made immediately, required number of retainers set to control train and brake system fully charged before proceeding.

WESTWARD

MABIE to Oroville Yard – One retainer for each 250 Tons in train. (Ruling Grade 1%)

MPK-52 to Westwood – One retainer for each 220 Tons in train. (Ruling Grade 1.5%)

ALMANOR to Greenville – One retainer for each 150 Tons in train. (Ruling Grade 2.2%)

EASTWARD

HALLS FLAT to Little Valley – One retainer for each 200 Tons in train. (Ruling Grade 1.8%)

SILVER ZONE to Wendover – One retainer for each 250 Tons in train. (Ruling Grade 1%)

When it is known before reaching any of the above locations that the use of retainers will be necessary, stop must be made and required number of retainers set before leaving the initially named points.

On other descending grades if the use of retainers becomes necessary, stop must be made and sufficient retainers set to control speed of train while brake pipe pressure is being restored.

When retainers are used they will be applied to cars on head end in a block of not less than ten cars. Retainers are to be used in the low pressure (horizontal) position. Should wheels show a tendency to heat, retainers must be alternated.

Formulae

1% = 6000 Ton – 250 Ton per = 24 Retainers
1.5% = 6000 Ton – 220 Ton per = 27 Retainers
1.8% = 6000 Ton – 200 Ton per = 30 Retainers
2.2% = 6000 Ton – 150 Ton per = 40 Retainers
vs. 100%

AVOID DAMAGE—SWITCH CUSTOMERS' CARS CAREFULLY

Damage to freight or car can be avoided by always keeping coupling speed within the safe range—NOT OVER 4 MILES PER HOUR—A BRISK WALK.

Handle freight carefully and keep our customers.

SPEED TABLE

TIME PER MILE	MILES PER HOUR
46"	78.3
47"	76.6
48"	75
49"	73.5
50"	72
51"	70.6
52"	69.2
53"	67.9
54"	66.7
55"	65.5
56"	64.3
57"	63.2
58"	62.1
59"	61
1'00"	60
1'01"	59
1'02"	58.1
1'03"	57.1
1'04"	56.2
1'05"	55.4
1'06"	54.5
1'07"	53.7
1'08"	52.9
1'09"	52.2
1'10"	51.4
1'11"	50.7
1'12"	50
1'13"	49.3
1'14"	48.6
1'15"	48
1'16"	47.4
1'17"	46.8
1'18"	46.2
1'19"	45.6
1'20"	45
1'25"	42.4
1'30"	40
1'35"	37.9
1'40"	36
1'45"	34.3
1'50"	32.7
1'55"	31.3
2'00"	30
2'15"	26.7
2'30"	24
2'45"	21.8
3'00"	20
3'30"	17.1
4'00"	15
5'00"	12
6'00"	10
7'00"	8.6
7'30"	8
8'00"	7.5
10'00"	6

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Attachment H-4

SUMMARY

Railroad Responses to Car Coupling Request

The following is a categorization of responses to the coupling speed request by EPA to the major rail carriers on January 3, 1979, and a subsequent follow-up in February 1979.

Response by R.R.

	Number	% of Total
. Have operating rule or special instruction of 4 mph maximum coupling speed................	34	42.5%
. Have recommended practice of 4 mph maximum coupling speed........................	20	25.0%
. Follow AAR recommended 4 mph coupling speed................................	10	12.5%
. No rules or recommendations on coupling speed..	16	20.0%
Totals	80	100%

Therefore, 64 of the 80 rail carriers (80%) have either a rule or recommendation of not-to-exceed 4mph in coupling. 42.5% have direct rules governing coupling speed of not-to-exceed 4mph. In no case was there a rule or recommended coupling speed maximum greater than 4 mph.

All rules and recommendations are in terms of a maximum safe speed to minimize or prevent freight loss and damage.

REFERENCES

1. Bolt Beranek and Newman, Inc.; Report No. 3873, 1978, Cambridge, Massachusetts.

APPENDIX I

U. S. COURT OF APPEALS DECISION

Notice: This opinion is subject to formal revision before publication in the Federal Reporter or U.S.App.D.C. Reports. Users are requested to notify the Clerk of any formal errors in order that corrections may be made before the bound volumes go to press.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 76-1353

ASSOCIATION OF AMERICAN RAILROADS, CHESAPEAKE AND OHIO RAILWAY COMPANY, CHICAGO AND NORTH WESTERN TRANSPORTATION COMPANY, AND SOUTHERN RAILWAY COMPANY, PETITIONERS

v.

DOUGLAS M. COSTLE, ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY AND THE ENVIRONMENTAL PROTECTION AGENCY, RESPONDENTS

THE STATE OF ILLINOIS, INTERVENOR

Petition for Review of an Order of the
Environmental Protection Agency

Argued 7 June 1977

Decided 23 August 1977

Judgment entered
this date
←

Bills of costs must be filed within 14 days after entry of judgment. The court looks with disfavor upon motions to file bills of costs out of time.

Richard J. Flynn, with whom *Lee A. Monroe* and *Joseph B. Tompkins, Jr.*, were on the brief, for petitioners.

Erica L. Dolgin, Attorney, Department of Justice, with whom *Peter R. Taft*, Assistant Attorney General and *Jeffrey O. Cerar*, Attorney, Environmental Protection Agency, were on the brief, for respondents.

Russell R. Eggert was on the brief for intervenor.

Before TAMM and WILKEY, *Circuit Judges*, and WILLIAM B. JONES,* *United States Senior District Judge* for the United States District Court for the District of Columbia

Opinion for the Court filed by *Circuit Judge* WILKEY.

WILKEY, *Circuit Judge*: In this petition for review,[1] the Association of American Railroads[2] (AAR) challenges the validity of the action of the Administrator of the Environmental Protection Agency (EPA) in promulgating Railroad Noise Emission Standards limited to rail cars and locomotives operated by surface carriers engaged in interstate commerce by railroad.[3] These regulations were promulgated pursuant to Section 17 of the Noise Control Act of 1972 (the Act) which requires the Administrator to establish emission standards for noise "resulting from operation of the equipment and facilities" of interstate rail carriers.[4] The petitioner does not challenge the validity of the noise emission standards set for rail cars and locomotives; rather, the AAR contends that the Administrator has interpreted the mandate embodied in Section 17 of the Act unlawfully in failing to establish standards for *all* of the "equipment and facilities" of interstate rail carriers. The EPA, on the other hand, argues that the Act vests the Administrator with discretion to determine which sources of railroad noise are to be regulated at the federal level.

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* Sitting by designation pursuant to Title 28, U.S.C. § 294 (c).

[1] This petition for review is properly before the court pursuant to 42 U.S.C. § 4915.

[2] The State of Illinois was allowed to intervene as a party respondent by order of this court on 18 May 1976.

[3] The regulations are stated at 40 C.F.R. §§ 201.11, 201.12, 201.13.

[4] 42 U.S.C. § 4916.

After carefully reviewing the language of the Noise Control Act and its legislative history, we conclude that the EPA has misinterpreted the scope of the mandate embodied in Section 17 of the Act through its artificially narrow definition of "equipment and facilities." Accordingly, we reverse the decision of the Administrator to limit the scope of the Railroad Noise Emission Standards and remand the case to the EPA with directions to promulgate noise emission standards in a manner not inconsistent with this opinion.

I. STATUTORY FRAMEWORK

The requirements for the regulation of railroad noise are contained in Section 17 of the Act. In pertinent part, this Section of the Act provides that:[4]

> (a) (1) Within nine months after October 27, 1972, the Administrator shall publish proposed noise emission regulations for surface carriers engaged in interstate commerce by railroad. Such proposed regulations shall include noise emission standards setting such limits on noise emissions resulting from operation of the equipment and facilities of surface carriers engaged in interstate commerce by railroad which reflect the degree of noise reduction achievable through the application of the best available technology, taking into account the cost of

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[4] *Id.*

> compliance. These regulations shall be in addition to any regulations that may be proposed under section 4905 of this title.
>
> (2) Within ninety days after the publication of such regulations as may be proposed under paragraph (1) of this subsection, and subject to the provisions of section 4915 of this title, the Administrator shall promulgate final regulations. Such regulations may be revised, from time to time, in accordance with this subsection.
>
> * * * *
>
> (c) (1) Subject to paragraph (2) but notwithstanding any other provision of this chapter after the effective date of a regulation under this section applicable to noise emissions resulting from the operation of any equipment or facility of a surface carrier engaged in interstate commerce by railroad, no State or political subdivision thereby may adopt or enforce any standard applicable to noise emissions resulting from the operation of the same equipment or facility of such carrier unless such standard is identical tc a standard applicable to noise emissions resulting from such operation prescribed by any regulation under this section.
>
> (2) Nothing in this section shall diminish or enhance the rights of any State or political subdivision thereof to establish and enforce standards or controls on levels of environmental noise, or to control, license, regulate, or restrict the use, operation, or movement of any product if the Administrator, after consultation with the Secretary of Transportation determines that such standard, control, license, regulation, or restriction is necessitated by special local conditions and is not in conflict with regulations promulgated under the section.

There are three points concerning the language of Section 17 which deserve mention at this point; an examination of these three points will serve to focus the analysis on the precise issue that forms the basis of the controversy in this case. There is a particularly strong need in this case to focus the discussion at an early stage since the parties, both in their briefs and at oral argument, have devoted much attention to issues which are either beyond peradventure or are not germane to the case in its present posture.[6]

First of all, it is clear from the language of Section 17(a)(1) and (2) that the Administrator is under a mandatory duty to establish noise emission standards for interstate rail carriers. The word "shall" is the language of command in a statute,[7] and there is no doubt that the Congress has commanded the Administrator of the EPA to promulgate railroad noise emission standards. In Section 17(a)(1), however, Congress went beyond commanding the Administrator to establish standards and sought to specify the subject matter to be regulated. In so specifying the subject matter, Congress also used the language of command—the regulations "*shall include*" standards setting limits on noise emanating from "the equipment and facilities" of interstate rail carriers.[8] In this sentence the phrase "shall include" refers to and incorporates the phrase "equipment and facilities" as the subject matter which *must* be included in the mandatory regulations. Thus, *both* the obligation to promulgate regulations and the subject matter to be regulated are dictated by the statute. Although there is a mandatory duty relative to "equipment and facilities," the statute does not attempt to define the phrase "equipment and facilities" beyond the use of the words themselves.

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[6] For example, the petitioner devotes substantial energy to the question of whether the Act has preemptive effect. *See* Brief of Petitioners at 9-32. The Act clearly has such an effect; *see* text at notes 10, 35, and 36, *infra.*

The respondents focus on the issue of whether the EPA has exercised its discretion in a reasonable manner; *see* Brief for Respondents 26-37. The discussion by respondents assumes that discretion is vested in the EPA: we have concluded that it does not and, therefore, this discussion of the reasonableness of the exercise of discretion is not relevant.

[7] *See, e.g., Boyden* v. *Comm. of Patents,* 441 F.2d 1041 (D.C. Cir. 1971).

[8] 42 U.S.C. § 4916(a)(1).

Given this strong mandatory language in the statute, we can brush aside subsidiary and diversionary issues to formulate the issue under review in this case as simply: with respect to the subject matter to be regulated, what is the scope of the Administrator's mandatory duty?[9]

The second point to be made concerning the language of Section 17 deals with the issue of preemption. It is clear that, under the Supremacy Clause of the Constitution, federal law can preempt state law in a particular subject area.[10] Congressional intent to preempt state and local regulation must at times be inferred from the overall structure of regulation found in the federal statute; such a need to infer is not present in this case. Section 17(c)(1) of the Act constitutes an explicit and direct preemption clause. Under the terms of this subsection, noise emission regulations relative to "the operation of any equipment or facility" of an interstate rail carrier will preempt state or local regulations dealing with the same sources of noise. In addition, the scope of the preemption provision appears clear; all regulations promulgated pursuant to Section 17(a)(1) and (2) are to have preemptive effect. That is, if a regulation comes within the scope of the mandatory duty specified in Section 17(a) (1) and (2), the regulation then displaces inconsistent state or local laws.

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[9] We emphasize that the question as to the *degree* of regulation to be applied to various noise sources is not before us in this case. The sole issue which we address concerns the question as to *what* is to be regulated.

[10] *See, e.g., Florida Lime & Avocado Growers, Inc.* v. *Paul*, 373 U.S. 132 (1963).

Thus, the existence and scope of federal preemption are not directly at issue in this case; the former is beyond doubt, while the latter is dictated by the scope of the mandatory duty to establish standards (which is the focus of this case).

The third and final point to be made concerning the language of Section 17 at this time concerns the provision for local variances under Section 17(c) (2) of the Act. Under this provision the Administrator may, after consultation with the Secretary of Transportation, allow states or localities to establish and enforce standards if such standards are "necessitated by special local conditions and [are] not in conflict with regulations promulgated under this section." [11] This provision for local variances has no effect on the scope of the mandatory duty outlined in Section 17(a), nor does it alter the preemption provisions of Section 17(c) (1); in fact, the nature of this provision would seem to confirm preemption. Section 17(c) (2) performs a valuable function in its recognition that local conditions may dictate some degree of flexibility in the approach to noise control. The provision does not, however, limit the scope of the Administrator's mandatory duty or the preemptive effect of the regulations issued pursuant to that duty.

In summary, by virtue of the language and structure of Section 17 of the Act, the relevant question for purposes of this analysis concerns the scope of the mandatory duty to regulate railroad noise. In particular, this scope is to be defined by reference to the phrase "equipment and facilities" in Section 17. Before turning to an exposition of what we believe to have been the Congressional intent behind this phrase, we shall examine the definition provided by the Administrator during the course of the rulemaking proceedings here under review.

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[11] 42 U.S.C. § 4916(c) (2).

II. PROCEDURAL BACKGROUND

The first formal step taken by EPA to implement Section 17 was the issuance of an advance notice of proposed rulemaking, which announced EPA's intent to develop regulations and invited the participation of all interested parties.[12] The comment period was subsequently extended to 1 June 1973.[13] On 3 July 1974 EPA issued a notice of proposed rulemaking in which the agency announced its intention to regulate rail cars and locomotives but not other railroad equipment or facilities.[14] The Administrator provided the following rationale for so limiting the regulations: [15]

> Many railroad noise problems can best be controlled by measures which do not require national uniformity of treatment to facilitate interstate commerce at this time. The network of railroad operations is imbedded into every corner of this country, including rights-of-way, spurs, stations, terminals, sidings, marshaling yards, maintenance shops, etc. Protection of the environment for such a complex and pervasive industry is not simply a problem of modifying noisy equipment, but get down into the minutiae of countless daily railroad operations at thousands of locations across the country. The environmental impact of a given railroad operation will vary depending on whether it takes place, for example, in a desert or adjacent to a residential area. For this reason, EPA

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[12] 38 Fed. Reg. 3086.

[13] 38 Fed. Reg. 10644.

[14] 39 Fed. Reg. 24580.

[15] *Id.* at 24580-81.

> believes that State and local authorities are better suited than the Federal government to consider fine details such as the addition of sound insulation or noise barriers to particular facilities, or the location of noisy railroad equipment within those facilities as far as possible from noise-sensitive areas, etc. There is no indication, at present, that differences in requirements for such measures from place to place impose any significant burden upon interstate commerce. *At this time*, therefore, it appears that national uniformity of treatment of such measures is not needed to facilitate interstate commerce and would not be in the best interest of environmental protection.
>
> The national effort to control noise has only just begun, however, and it is inevitable that some presently unknown problems will come to light as the effort progresses. Experience may teach that there are better approaches to some aspects of the problem than those which now appear most desirable. The situation may change so as to call for a different approach. Section 17 of the Noise Control Act clearly gives the Administrator of the Environmental Protection Agency authority to set noise emission standards on the operation of all types of equipment and facilities of interstate railroads. If in the future it appears that a different approach is called for, either in regulating more equipment and facilities, or fewer, or regulating them in a different way or with different standards consistent with the criteria set forth in Section 17, these regulations will be revised accordingly.

After publication of the proposed regulations, EPA made available a detailed "Background Document" for the regulations; this document is significant for the candor and frankness with which it explains the agency's decision to limit its regulation.[14] After this, a public hearing was held and further written comments were solicited and received.[17] The AAR submitted written comments on 27 August 1974 in which the organization put forth the same arguments being pursued in this appeal.[18] The EPA rejected these arguments and published the final, but limited, regulations on 14 January 1976. This petition for review of the final regulations was then timely filed on 14 April 1976.[19]

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[14] The document is reproduced in the Joint Appendix (J.A.) at 28-51. *See also* text and notes at notes 45 to 48, *infra*.

There are two major themes in the EPA's justification for limiting its regulation which should be identified at this point. The first concerns the issue of timing; EPA has repeatedly stated that it is limiting the subject matter of its noise standards "at this time." The agency has during the course of its administrative proceedings specifically reserved the option to regulate all aspects of railroads "equipment and facilities" in the future.

The second theme is related to the first; while declining to regulate additional equipment and facilities at this time, the Administrator explicitly or impliedly encouraged state and local jurisdictions to adopt noise emission standards for some types of equipment and facilities. As EPA stated,[20]

> "Although the EPA does not currently propose to regulate retarder noise, it does recommend that local jurisdictions establish regulations which require railroads to utilize barrier technology where needed and where both practical and feasible . . .
>
> "They [local and state jurisdictions] may adopt and enforce noise emission standards on other pieces of equipment not covered by EPA regulations, such as retarders and railroad construction equipment . . .

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[17] 39 Fed. Reg. 24586.

[18] J.A. at 117-160.

[19] *See* 42 U.S.C. § 4915.

[20] *See* J.A. at 18, 24-25.

> "State and local governments may enact noise emission standards for facilities which EPA has not regulated. However, . . . where federally regulated equipment is a noise contributor in a facility on which a State or local government proposes to set a noise emission standard, such as a marshalling yard, such regulation may or may not be preempted . . .
>
> ". . . EPA believes that design or equipment standards on federally regulated equipment—viz., locomotive and rail cars—are preempted. Design or equipment standards on other pieces of equipment such as retarders or cribbing machines, are not preempted. Similarly, design standards on facilities not federally regulated are not preempted, even though locomotives and rail cars may operate there, because they do not require the modification of locomotives or rail cars. An example of this type of regulation would be a local ordinance requiring that noise barriers be installed along the rights of way running through that community."

Thus, although EPA recognized the need for additional regulation, the agency did not take it upon itself to meet this need through EPA-sponsored regulations. In addition, the encouragement of local regulation was subject to the EPA's reservation of power to regulate in those same areas in the future. This facet of the agency's position will assume a prominent role in our analysis in Part III, *infra*.

In summary, the administrative process described above resulted in standards regulating noise from only three sources: 1) locomotive operation under stationary conditions;[21] 2) locomotive operation under moving conditions;[22] and 3) rail car operations.[23] No other types of railroad equipment and no railroad facilities *at all* are within the coverage of the promulgated standards. Specifically, the following "equipment and facilities" are excluded from federal regulation: horns, bells, whistles and other warning devices; respair and maintenance shops, terminals, marshalling yards, and rail car retarders; special purpose equipment, such as cranes, derricks, and other types of maintenance-of-way equipment; and track and rights-of-way.[24] The propriety of excluding these sources of noise from regulation in light of the statutory mandate in Section 17(a) of the Act will now be examined.

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[21] 40 C.F.R. § 201.11.

[22] *Id.* at § 201.12.

[23] *Id.* at § 201.13.

III. ANALYSIS

A. *Statutory Language*

1. *Section 17(a)(1).* The starting point for an analysis of the scope of the subject matter to be regulated pursuant to the Administrator's mandatory duty to publish noise emission regulations must be the language of Section 17(a)(1). As noted previously, "shall include" refers to "the equipment and facilities" in this context;[25] the definition of the latter phrase dictates the scope of the mandatory subject matter. We believe that the reference to "*the* equipment and facilities" is unambiguous. The plain meaning of this phrase yields a definition that would, in the absence of any contradictory evidence, subsume *all* such equipment and facilities. There is absolutely no indication in Section 17(a)(1) that Congress intended to vest discretion in the EPA to decide *which*

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[24] This listing is not meant to be an exhaustive compilation of the subject matter included within the phrase "equipment and facilities." The definition of this term must be made by the agency with a realistic reference to the definition of the term customarily employed in the railroad industry. *See* text and notes at notes 45 to 48, *infra.*

[25] *See* text and notes at notes 7 to 8, *supra.*

of *the* equipment and facilities would be subject to regulation. Nothing in the statute diminishes or qualifies the generality of these two key words—*equipment* and *facility*. Nothing in the statute states that only certain kinds of equipment or facilities need to be regulated. The plain and natural meaning of the phrase "the equipment and facilities" is that the power of the EPA is plenary with respect to those objects and places customarily thought to be included in the definition of the phrase. To read this language otherwise would be to distort a relatively clear signal from the national legislature. Indeed, in the context of this case, the EPA chose not to regulate any "facilities" at all; this action in effect reads this word out of the statute. We are not prepared to label this word as being superfluous to the statutory mandate.[26]

The EPA presents only one argument with respect to the statutory language in Section 17(a)(1). The agency contends that "[i]f Congress had meant to require EPA to regulate *all* equipment and facilities it could easily have said so by using the word 'all' rather than the word 'the.'"[27] This is perhaps the weakest of all statutory construction arguments, particularly where, as here, the proponent of the argument puts forth alternative language which Congress should have used which has substantially the same meaning as the language which Congress did employ. The principle being contended for by the EPA with respect to the language of Section 17(a)(1) has no limits; it is the last refuge for those who find themselves in the unenviable position of having to argue against the plain meaning of statutory language. Although EPA can draw no support from the language of Section 17(a)(1), the agency seeks to establish the existence of discretion to choose among various equipment and facilities by reference to the language of the preamble of the Act.[28]

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[26] Of course, the EPA has reserved the option to regulate "facilities" in the future (see note 15, *supra*). The EPA thus believes that it can choose the timing of its regulations, a proposition with which we disagree. *See* text and notes at notes 49 to 50, *infra*.

[27] Brief for Respondents at 10.

2. *The Preamble.* The EPA makes much of the fact that the preamble to the Act states that

> while primary responsibility for control of noise rests with State and local governments, Federal action is essential to deal with *major* noise sources in commerce control of which require national uniformity of treatment.[29]

EPA would have us read this language as if it said that the Federal government can regulate *only* "major noise sources."

The EPA argument based on the language in the preamble is based on an erroneous perception of the operation and significance of such language. A preamble no doubt contributes to a general understanding of a statute, but it is not an operative part of the statute and it does not enlarge or confer powers on administrative agencies or officers.[30] Where the enacting or operative parts of a statute are unambiguous, the meaning of the statute cannot be controlled by language in the preamble. The operative provisions of statutes are those which prescribe rights and duties and otherwise declare the legislative will. In the context of this case, the operative provisions of the statute which declare the will of Congress with respect to railroad noise emissions are those contained in Section 17 of the Act. We find the reference to "the equipment and facilities" in Section 17(a)(1) to be unambiguous and, therefore, do not look to the preamble for guidance as to the legislative intent.

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[28] Respondents refer us to other statutory language in various subsections of Section 17; *see* Brief for Respondents at 12-14. We find these arguments to be clearly frivolous and insubstantial and therefore do not address them in detail in this opinion.

[29] 42 U.S.C. § 4901(a)(3).

[30] *See, e.g., Yazoo Railroad Co.* v. *Thomas,* 132 U.S. 174, 188 (1889).

B. *Legislative History*

Our conclusion that the language of Section 17(a)(1) itself is an unambiguous reference to all "equipment and facilities" forecloses the necessity of looking to the legislative history for resolution of this issue. In the interest of thoroughness, however, we have scrutinized the legislative history and believe that it is consistent with our reading of the language of the Act. In addition, the legislative history provides an important insight into why the justification offered by the EPA for the narrowness of the scope of its regulations is incorrect.

The only legislative Committee Report to touch on the provisions relating to railroad noise regulation is the Report of the Senate Committee on Public Works.[31] The Report of the House Committee on Interstate and Foreign Commerce, accompanying the House noise control bill (H.R. 11021),[32] contains no mention of railroad noise emissions because the House bill did not contain a section on railroad noise either as introduced or as first passed by the House.

The Senate Committee Report summarized the railroad section of the law as follows:[33]

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[31] S. Rep. No. 92-1160, 92d Cong., 2d Sess. (1972).

[32] H. Rep. No. 92-842, 92d Cong., 2d Sess. (1972).

[33] S. Rep. No. 92-1160, *supra*, note 31, at 18-19.

> "*Part B—Railroad Noise Emission Standards*
>
> This part (Sections 511 through 514) provides a Federal regulatory scheme for noise emissions from surface carriers engaged in interstate commerce by railroad. The Administrator of the Environmental Protection Agency is required to publish within 9 months after enactment and promulgate within 90 days after publication noise emission standards for railroad equipment and facilities involved in interstate transportation, including both new and existing sources. Such standards must be established on the basis of the reduction in noise emissions achievable with the application of the best available technology, taking into account the cost of compliance.
>
> Standards take effect after the period the Administrator determines necessary to develop and apply the requisite technology, and are implemented and enforced through the safety inspection and regulatory authority of the Secretary of Transportation, as well as through Title IV.
>
> Based on the interrelationship between the need for active regulation of moving noise sources and the burdens imposed on interstate carriers by differing State and local controls, the Federal regulatory program for railroads under this part completely preempts the authority of State and local governments to regulate such noise after the effective date of adequate Federal standards, except where the Administrator determines it to be necessitated by special local conditions or not in conflict with regulations under this part."

Although the language in the report offers no insight into the meaning of the phrase "equipment and facilities," it does provide evidence as to the major policy justification for the broad preemptive effect accorded to the railroad noise emission standards. Congress was clearly concerned about "the burdens imposed on interstate carriers by differing State and local controls. . . ." This concern was expressed repeatedly in the Senate debate on the Act. Two excerpts from this debate serve to illustrate this concern:

Senator Randolph:

> "I also bring to the attention of the Senate the provisions in title V of S. 3342, which establishes a regulatory framework for noise from interstate trucks and buses and the operations of railroads. Here, as well as in the area of product noise emission standards, the transportation industry is faced with the prospect of conflicting noise control regulations in every jurisdiction along their routes. It is completely inappropriate for interstate carriers or interstate transportation to be burdened in this way. The committee met the need for active legislation on moving noise sources by requiring controls on noise from all interstate trucks and buses and railroads, including existing equipment which would not otherwise be subject to produce noise emission standards under title IV and the patterns of operations of such carriers. After the effective date of an adequate Federal regulation program, the authority of State and local governments to regulate noise from interstate trucks and buses or trains is completely preempted, except where the Administrator determines it would be necessitated by special local conditions or in no conflict with the Federal requirements." [34]

* * * *

> "Mr. HARTKE. Mr. President, one of the basic purposes of title V of this bill, as explained in the committee report, is to assure the maximum practical uniformity in regulating the noise characteristics of interstate carriers such as the railroads and motor carriers which operate from coast to coast and through all the States, and in hundreds of communities and localities.

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[34] 118 Cong. Rec. 35412 (1972) (Remarks of Senator Randolph).

> "Without some degree of uniformity, provided by Federal regulations of countrywide applicability which will by statute preempt and supersede any different State and local regulations or standards, there would be great confusion and chaos. Carriers, if there were not Federal preemption, would be subject to a great variety of differing and perhaps inconsistent standards and requirements from place to place. This would be excessively burdensome and would not be in the public interest." [33]

This concern for "maximum practical uniformity" is *certainly* consistent with a broad definition of "equipment and facilities." But the EPA has put forth a curious notion as to which equipment and facilities are in need of such uniform treatment with respect to noise emission standards.

EPA justifies its narrow view of equipment and facilities by arguing that if a source of noise is subject to the regulation of only one jurisdiction, there is no need for national uniformity. EPA believes that national uniformity is needed only in those situations in which the noise source is potentially subject to noise regulation by more than one jurisdiction (such as locomotive or rail cars).[34] This view ignores the fact that, although a physical source of noise—for instance, a particular yard or terminal ("facilities")—may be permanently located in only one jurisdiction, the *railroad that owns it* will own other yards and terminals in many other jurisdictions through which its system extends. The railroad itself (the carrier specified in Section 17(a)(1) of the Act), as distinguished from the single yard, will be subject to conflicting or differing noise regulations of the jurisdictions in which all of the various yards are located. Such multiple exposure could easily create the type of burdens which Congress sought to avoid in the Noise Control Act. By giving the phrase "the equipment and facilities" its natural meaning, nationally uniform regulations will extend to the various elements subsumed in this phrase, in furtherance of this major policy underlying the Act.

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[33] 118 Cong. Rec. 35881 (1972) (Remarks of Senator Hartke).

[34] *See* Background Document, J.A. at 37-45.

We emphasize that the discussion in this section of the opinion concerns a policy justification underlying the Act and does not focus on the statutory language. There is no language in Section 17 which mandates that the Administrator regulate *only* those equipment and facilities in need of national uniform treatment. But this question of uniformity is supportive of our reading of the contested phrase, and the manner in which the Administrator applied the uniformity concept is important to an understanding of the EPA's earlier, limited action. It is for these reasons that we have discussed this issue.

C. *Other Arguments*

The analysis thus far in Part II has focused on the statute itself and the legislative history. We now address several additional arguments raised by the EPA.

The EPA argues that its interpretation of the Noise Control Act should be accorded deference by a reviewing court because it is the agency charged with administering the Act.[37] While it is an established principle of administrative law that reviewing courts will generally "show 'great deference to the interpretation given [a] statute by the officers or agency charged with its administration,' "[38] this principle has no application where, as here, the agency has misinterpreted its statutory mandate.[39]

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[37] *See* Brief for Respondents at 7-8.

[38] *Udall* v. *Tallman*, 380 U.S. 1 (1965).

[39] *See, e.g., Freeman* v. *Morton*, 499 F.2d 494 (D.C. Cir. 1974).

In such cases of misinterpretation, it is our duty to correct the legal error of the agency as we have done here. In this regard, we also note that the Interstate Commerce Commission, the Department of Transportation, and the Department of Commerce—three federal agencies which can all lay claim to considerable expertise relative to the railroad industry and its role in interstate commerce—all strongly disagreed with the EPA's decision not to regulate all "equipment and facilities" of interstate rail carriers.[40] We point to this as additional evidence that our failure to defer to the agency decision in this case is not unwarranted.

The EPA argues quite strenuously that "practical factors" compel the conclusion that Congress did not intend all railroad equipment and facilities to be regulated.[41] EPA contends that "[i]t is inconceivable that Congress intended EPA to investigate and control every inconsequential piece of railroad equipment. . . ." [42] EPA then proceeds to list a variety of sources which it believes would be encompassed by the AAR's position in this case. EPA raises the specter that it will have to regulate elevators, air conditioners, typewriters, telephones, parking lots, and delivery vans because these sources are subsumed under a strict, literal interpretation of the phrase "equipment and facilities." [43]

We do not find this argument convincing. The courts are, of course, concerned with the consequences of the decisions which they render; they will examine these consequences as a factor in determining whether to grant the relief requested by the complaining party in a particular case. The consequences of the position we take in this case are not of the variety that cast doubt on the wisdom of the decision, however. This is because the position advocated by EPA *counsel* in this case is an artificial one; the AAR has not contended that the EPA must thrust its presence into every minute detail of railroad office buildings,[44] nor is such a position required by what appears to be the customary definition of "equipment and facilities" in the railroad industry.

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[40] *See* J.A. at 214-16, 210, 189.

[41] Brief for Respondents at 22.

[42] *Id.* at 23.

[43] *Id.* at 22-23

The EPA itself (as opposed to EPA counsel in this case) has shown that it is capable of defining "equipment and facilities" in a realistic and reasonable manner. In Section 5 of its "Background Document for Railroad Noise Emission Standards," the EPA has identified broad categories of railroad noise sources in order "to identify [the] types of equipment and facilities requiring national uniformity of treatment." [45] The agency then proceeds to list the following categories: office buildings; repair and maintenance shops; terminals, marshalling yards, humping yards, and railroad retarders; horns, whistlers, bells, and other warning devices; special purpose equipment (listing nineteen pieces of such equipment; track and right-of-way design; and trains (locomotives and rail cars).[46] As noted previously, the EPA chose to regulate only this last category relating to locomotives and rail cars.[47] *With respect to each of the additional categories* of railroad equipment and facilities that generate noise, the EPA declined to regulate *but reserved the option to establish standards in the future.*[48]

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[44] Reply Brief of Petitioners at 3-5.

[45] Background Document, J.A. at 37.

[46] *Id.*, J.A. at 37-44.

[47] *See* text at notes 14 to 19, *supra*.

[48] *See* note 46, *supra*.

Two points of significance emerge from the foregoing discussion. First, the EPA has demonstrated that it is capable of defining the phrase "equipment and facilities" in a manner consistent with customary usage of the phrase in the industry. Congress often does not specify in detail phrases that have an established meaning within a particular industry; such definitions are best developed with reference to the actual context of the regulated industry in question. We stress that the task of defining "equipment and facilities" is a matter to be accomplished within the structure of the EPA's rulemaking procedures; we do not undertake to provide a detailed definition in this opinion. We do, however, conclude that the EPA has interpreted its statutory mandate too narrowly in regulating only locomotives and rail cars, and *no* facilities at all. The EPA counsel have offered us an extreme definition of "equipment and facilities" in an attempt to have us reject the AAR's position. The EPA itself has shown that it can bring a measure of reason to a discussion of this definitional issue; on this on remand we rely.

The second point concerns EPA's insistence that it has the option to regulate the enumerated "equipment and facilities" in the future. In our view, the EPA has virtually admitted the error of its interpretation of Section 17 in making this argument. Section 17(a)(1) makes no provision for a "phasing in" of the required regulations over a period of time; the provision does not have a temporal element in which the agency determines *when* to initiate the federal regulatory machinery. There *is* a temporal element in Section 17(a)(2); this provision states that "such regulations may be *revised*, from time to time. . . ."[49] In this context, "such regulations" refers to the mandatory regulations prescribed in Section 17(a)(1). Section 17(a)(2) therefore provides for the "fine tuning" of the mandatory regulations; there is no provision for a delay in the timing of the *original issuance* of the mandatory standards themselves.

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[49] 42 U.S.C. § 4916(a)(2).

Therefore, if a certain subject matter is properly included within the term "equipment and facilities," the EPA has jurisdiction over the subject matter. If the EPA has such jurisdiction, it must exercise it in accordance with the mandate of Section 17(a)(1). In its "Background Document" *the EPA has claimed future jurisdiction over a broad range of "equipment and facilities;"* [50] this claim in effect admits that *the phrase properly encompasses a much broader range of objects and places. This admission in turn dictates the conclusion that the original regulations were much too narrow in scope.*

In its construction of Section 17(a)(1), the EPA has attempted to secure for itself the best of both worlds; that is, to limit current regulation while reserving plenary power to regulate in the future. This is perhaps an understandable effort to introduce an element of flexibility into the promulgation of noise emission standards. It is not, however, for us as a reviewing court to add this dimension of flexibility to the statutory framework. Congress has dictated that the EPA regulate "the equipment and facilities" of interstate rail carriers. Congress has *not* provided the agency with the type of discretion it evidently desires and contends for in this case. We are bound to effectuate the legislative will and we perceive it to be unambiguous in this context. If the EPA desires an element of flexibility in its operations, the agency must look to the Congress and not to the courts.

In addition to the arguments already presented, we perceive a highly unfavorable consequence of EPA's position that it can refrain to regulate at this time while reserving the option to regulate in the future. As noted previously, the EPA has encouraged local jurisdictions to regulate particular noise sources which it (the EPA) chooses not to regulate at this time. If the localities take this suggestion seriously, they may well invest considerable resources and time in developing and promulgating local noise ordinances. But the EPA claims the authority to issue regulations covering the *same* noise sources at *any* time in the future. It is clear that these EPA-issued regulations would, under Section 17(c)(1) of the Act, preempt the locally developed standards. Thus, the localities could not be sure when and if a federal regulation would displace their own and with it the time and resources devoted to the promulgation of the local standard. We believe that the structure of Section 17 of the Act comprehends some consideration for the localities in this regard.

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[50] *See* note 46, *supra.*

If the federal level issues all of its regulations concerning "equipment and facilities" at one time; the localities can plan their own activities in the area of noise regulation with increased certainty and confidence that their efforts will not go for naught. Also, once the federal regulations are issued, the localities will be able to discern whether or not they should attempt to trigger the variance provisions found in Section 17(c)(2) of the Act. Therefore, we believe that our decision in this case is consistent with the overall structure of the Act as it applies to railroad noise emission standards.

IV. RELIEF

Section 10(e) of the Administrative Procedure Act states that[n]

> [t]o the extent necessary to decision when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provi-

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[n] 5 U.S.C. § 706.

sions, and determine the meaning of applicability of the terms of an agency action. The reviewing court shall—

(1) compel agency action unlawfully withheld or unreasonably delayed.

* * * *

Having concluded that the Administrator of the EPA misinterpreted the clear statutory mandate to regulate "the equipment and facilities" of interstate rail carriers, we direct that the Administrator reopen the consideration of Railroad Noise Emission Standards and promulgate standards in accordance with the statutory mandate as interpreted herein. Several observations concerning the nature of the inquiry on remand are in order.

Although the Administrator construed the term "equipment and facilities" in a narrow and artificial manner, we do not in this opinion dictate what we believe to be a proper definition of the term. Rather, we believe that Congress intended for this definition to be developed by the agency in a manner that is consistent with the customary usage of the phrase in the railroad industry.[52] The EPA has shown that it has a realistic understanding of what is included within railroad "equipment and facilities," and we would expect them to apply this same realistic approach on remand. This does not mean that they must adopt the precise definition outlined in Section 5 of the Background Document; it does mean that the realities of the railroad industry must govern the definition, not the predilections of the agency as to what it is prepared to regulate.

Second, nothing we do herein affects the *degree* of regulation which the Administrator deems desirable in a particular context. We are concerned at this point only that the Administrator broaden the scope of the *subject matter* regulated so as to bring the coverage of the regulations in line with the Congressional mandate in Section 17 of the Act. The particular *manner* in which the "equipment and facilities" are regulated is a matter which rests, in the first instance, with the Administrator. This action is, of course, reviewable, but under a different standard and at a future date.

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[52] This definition will, of course, be reviewable in the courts.

Third, there is the matter of the time within which the Administrator must promulgate the regulations concerning "equipment and facilities." The original statutory command was that the Administrator publish proposed regulations within nine months from 27 October 1972;[33] these proposed regulations were then to be promulgated as final regulations within ninety days after the publication of the proposed regulations.[34] We believe that this original timetable evidences a Congressional concern that the regulations be issued expeditiously. Accordingly, we believe that our mandate should embrace this concern for a prompt treatment of the noise emission standards. Therefore, we direct that the consideration on remand proceed as promptly as possible and, in any event, that the final regulations be issued within one year from the date on which the mandate in this case is issued.

Fourth, and finally, our holding in this case does not affect the validity of the individual Railroad Noise Emission Standards already issued. These may continue in effect. Our sole directive is that the EPA broaden the scope of its regulations by defining "the equipment and facilities" of interstate rail carriers in a manner consistent with the usual and customary understanding of the phrase in the railroad industry.

So Ordered.

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[33] 42 U.S.C. § 4916(a)(1).

[34] *Id.* at § 4916(a)(2).

APPENDIX J

RAILROAD CASH FLOW MODEL

PRESENT VALUE ANALYSIS

Assumptions

1. Horizon equals 20 years (January 1, 1980 to December 31, 1999).

2. Annual inflation rate equals 6%

3. Discount rate for present value analysis equals 10%

4. Marginal tax rate equals 46%

5. Pollution abatement equipment is depreciated by the straight-line method, with a salvage value equal to zero. Equipment is replaced when fully depreciated, except for mufflers for switch engines. Replacement mufflers represent a current maintenance expense after the initial muffler is worn out (in accordance with ICC accounting principles).

6. All pollution abatement equipment qualifies for an investment tax credit under Section 38 property. The tax credit is equal to 10 percent of capital expenditure. It is assumed that the full investment tax credit will be taken in the year in which equipment is acquired and put into use.

Computations

1. Cash Flow — The 1973 through 1978 average is assumed to be the first observation in the annual stream beginning January 1, 1980. Cash flow is defined here as net income after taxes, interest and extraordinary items plus deferred taxes, less equity in earnings of affiliates; depreciation is not added back in the baseline cash flow estimate.

$$CF = NI + DEFT - EQ.$$

For each railroad, the cash flow average was inflated by 6% per year, discounted by 10% and summed to derive a net present value of the twenty-year stream of cash flows. This is equivalent to a present value of annuity calculation. Present values of future cash flows appear in the first column of Table J-5.

2. Net Worth -- The 1973 through 1978 average was assumed to be the net worth as of January 1, 1980. This appears in the second column of Table J-5 as average net investment.

3. Net present values of future cash flows are calculated by reducing the present values of future cash flows by net investment or net worth. This is listed by railroad in the last column of Table J-5. Those railroads displaying an average negative net worth are eliminated from further net present value analyses. However, their abatement cash flow charge is calculated.

4. Capital Expenditures are detailed by yard type for each railroad, showing the year in which the expenditure is made. The cost of each treatment that is applicable to each noise source is multiplied by the number of sources. Equipment is replaced and additional expenditures made when fully depreciated. Table J-6 lists capital expenditures for all railroads. In addition, Table J-8 lists initial capital expenditures for all railroads; this differs from Table J-6 in that Table J-8 shows no replacement when equipment is fully depreciated.

Present values of capital expenditures are computed by inflating cost data at 6% per year from January 1, 1980 and discounted to the present at a 10% rate. Present value factors appear in Table J-4.

5a. Annual Operating Costs Due to Abatement -- Noise related O&M, out-of-service and depreciation costs are computed for each year of the analysis, using O&M and out-of-service cost estimates for each source and capital expenditure and useful life data for each fix applicable to each source. These data appear in Tables J-3A and J-3B. A listing of total O&M costs and depreciation cost (in the accounting sense) appear in Tables J-9, J-10 and J-11, respectively. The effect of taxes is considered in the analysis and thus the before and after tax cost must be determined. O&M and out-of-service costs have an after tax cost of (1-t); depreciation has a tax "shield" in the sense of cash flow, equal to tax depreciation expense. These costs are separated by source, before and after taxes, and are totalled for each railroad. These costs are in 1979 dollars.

Because the abatement cost data are to be used in the cash flow analysis, they must be adjusted for the impact they have on cash flow. Out-of-service costs, because they are treated as a period cost with the same tax impact as O&M, will be included hereinafter in the general discussion of O&M costs.

5b. O&M Costs -- In the abatement scenario, adjusted cash flow (CF) is reduced by the additional O&M costs, offset somewhat by the reduction of taxes which arise because of the reduced net income (from the increased O&M costs), that is,

$$\begin{aligned} CF_{O\&M} &= -\Delta O\&M + t(\Delta O\&M) \\ &= -\Delta O\&M(1-t) \end{aligned}$$

where t = tax rate.

5c. Depreciation -- In a similar manner, increased depreciation for abatement equipment changes baseline cash flow. Depreciation is a non-cash expense which reduces taxes and thus has a positive effect on railroads' cash flow. Initially,

$$\begin{aligned} CF_{DEP} &= -\Delta DEP + t(\Delta DEP) \\ &= -\Delta DEP(1-t) \end{aligned}$$

However, a basic premise in cash flow analysis is that flows are considered, not accounting charges and credits. Thus, all non-cash items are added back to after-tax net income.

$$\Delta CF = -\Delta O\&M(1-t) + [-\Delta DEP(1-t)] + \Delta DEP$$

$$\Delta CF = -\Delta O\&M(1-t) - \Delta DEP(1-t) + \Delta DEP$$

reduced,

$$\Delta CF = -\Delta O\&M(1-t) + \Delta DEP(t).$$

Abatement-related depreciation expense is shown in Table J-11 by noise source for each railroad. The net after tax effect for cash flow analysis appears on the right side of this table ($\Delta DEP \times t$). The tax rate, denoted by t, is assumed to be 46% (the marginal rate for corporate income above $100,000 for years beginning after 1978).

5d. Investment tax credits, generated by capital expenditures, are treated as an annual item to increase cash inflows (or decrease cash outflows). Investment tax credits are taken at the full rate of 10% of capital expenditures and are taken the year in which the asset is acquired and assumed put in place (original acquisition or replacement year). It is assumed that there are no limitations on investment tax credits, and all equipment is eligible for full tax credit. Table J-12 lists total investment tax credits available to each railroad in 1979 dollars.

6a. The total change in cash flow is finally derived by increasing CF by the investment tax credit in those years in which equipment is acquired. The present value is computed for each year by applying the present value factor and summing this stream of incremental cash flows.

$$\Delta CF = -\Delta O\&M(1-t) + \Delta DEP(t) + ITC$$

$$PV\Delta CF = \sum_{i=1980}^{1999} PV \quad (-\Delta\, O\&M_i(1-t) + \Delta\, DEP_i(t) + ITC_i)$$

6b. The net present value of abatement cash flow is then determined by reducing the present value of change in cash flows by the present value of the capital expenditures.

$$NPVACF = PV\Delta CF - PVCAP$$

$$NPVACF = \sum_{i=1980}^{1999} PV(-\Delta O\&M_i(1-t) + \Delta DEP_i(t) + ITC_i) - \sum_{i=1980}^{1999} PVCAP_i$$

6c. Table J-13 lists the net present value of change in abatement cash flows by yard type for each railraod.

7. In Table J-13, when the net present value of abatement cash flow (NPVACF) (Column 4) is subtracted from the net present value of future cash flows (NPVFCF) (Table J-5, Column 3), the net present values of future cash flows with abatement (NPV) are determined. This final net present value is listed in the last column of Table J-13.

$$NPV = NPVFCF -(-NPVACF)$$

$$NPV = NDVFCF + NPVACF$$

8. Table J-14 lists all railroads with a positive net present value of future cash flows after abatement. Table J-15 lists those with a negative or zero net present value. This net present value of future cash flows is an indication of the ability of a railroad to implement changes required by the regulation. Further, the net present value of future cash flows before abatement (Table J-5) gives a basis for comparison to assess how much of an impact, positive or negative, the regulation will have on the railroad's future cash flows.

9. To examine further, the net present value of abatement cash flows is compared to the net investment (average net worth). If the net present value is positive but relatively small, potential financial difficulty may be present. For this analysis, relatively small is interpreted to mean a difference which is positive but less than 10% of net worth.

For railroads with a positive difference greater than 10%, further analysis is suggested only if abatement costs appear unusually large relative to other data.

A ratio is calculated by dividing the net present value of abatement cash flows by the net worth. Those railroads with a ratio greater than zero but less than 0.10 are listed in Table J-16, those with a ratio greater than 0.10 are listed in Table J-17, and those with a ratio less than zero are listed in Table J-18.

Table J-1

REGULATORY SCENARIO

EFFECTIVE DATE	A-WEIGHTED SOUND LEVEL	REGULATED SOURCES
January 15, 1984	83 dB	Retarders
	78 dB	Load Cell Test Stands
	70 dB (idle)	Switch Engines
	90 dB (moving)	
	92 dB	Car Coupling

Table J-2 (Option 1)

CASH FLOW ANALYSIS BASED ON ONAC SOUND EMISSION STANDARDS MODEL (CABOOSES)

	NOISE SOURCE		
RAILROAD NAME	RETARDERS	LOAD CELL TEST SITES	SWITCHERS
1 BO BALTIMORE & OHIO RR CO.	4	0	63
2 BAR BANGOR & AROOSTOOK RR CO.	0	0	2
3 BLE BESSEMER & LAKE ERIE RR CO.	0	1	0
4 BM BOSTON & MAINE CORP.	1	1	30
5 CP CANADIAN PACIFIC (IN MAINE)	0	0	1
6 CV CENTRAL VERMONT RWY CO.	0	0	1
7 CO CHESAPEAKE & OHIO RWY CO.	3	10	50
8 CIM CHICAGO & ILLINOIS MIDLAND RWY CO.	0	0	3
9 CR CONRAIL	19	14	980
10 DH DELAWARE & HUDSON RWY CO.	0	1	19
11 DTS DETROIT & TOLEDO SHORELINE RR CO.	1	0	0
12 DTI DETROIT, TOLEDO & IRONTON RR CO.	1	0	10
13 EJE ELGIN, JOLIET & EASTERN RWY CO.	1	1	42
14 GTW GRAND TRUNK WESTERN RR CO.	0	1	50
15 ITC ILLINOIS TERMINAL RR CO.	0	1	1
16 LI LONG ISLAND RR CO.	1	1	8
17 MEC MAINE CENTRAL RR CO.	0	1	11
18 NW NORFOLK & WESTERN RWY CO.	4	7	173
19 PLE PITTSBURGH & LAKE ERIE RR CO.	0	1	37
20 RFP RICHMOND, FREDERICKSBURG & POTOMAC RR CO	1	0	8
21 WM WESTERN MARYLAND RWY CO.	1	0	0
22 CCO CLINCHFIELD RR CO.	0	1	7
23 FEC FLORIDA EAST COAST RWY CO.	0	1	7
24 GA GEORGIA RR CO.	0	0	4
25 ICG ILLINOIS CENTRAL GULF RR CO.	2	7	91
26 LN LOUISVILLE & NASHVILLE RR CO.	2	1	84
27 SCL SEABOARD COAST LINE RR CO.	2	4	88
28 SOU SOUTHERN RY. SYSTEM	5	2	100
29 ATSF ATCHISON, TOPEKA & SANTA FE RWY CO.	2	5	74
30 BN BURLINGTON NORTHERN CO.	6	13	294
31 CNW CHICAGO & NORTHWESTERN TRANSP. CO.	1	7	77
32 MILW CHICAGO, MILW., ST. PAUL & PACIFIC RR CO	2	14	110
33 RI CHICAGO, ROCK ISLAND & PACIFIC RR CO.	1	5	83
34 CS COLORADO & SOUTHERN RWY CO.	0	0	7
35 DRGW DENVER & RIO GRANDE WESTERN RR CO.	1	1	22
36 DMIR DULUTH, MISSABE & IRON RANGE RWY CO.	0	1	14
37 DWP DULUTH, WINNIPEG & PACIFIC RWY	0	0	0
38 FWD FORT WORTH & DENVER RWY CO.	0	1	3
39 KCS KANSAS CITY SOUTHERN RWY CO.	0	1	51
40 MKT MISSOURI-KANSAS-TEXAS RR CO.	0	1	27
41 MP MISSOURI PACIFIC RR CO.	2	4	108
42 NWP NORTHWESTERN PACIFIC RR CO.	0	0	5
43 SLSF ST. LOUIS-SAN FRANCISCO RWY CO.	1	1	52
44 SSW ST. LOUIS SOUTHWESTERN RWY CO.	1	0	39
45 SOO SOO LINE RR CO.	0	1	26
46 SP SOUTHERN PACIFIC CO.	5	15	300
47 TM TEXAS MEXICAN RWY CO.	0	0	0
48 TPW TOLEDO, PEORIA & WESTERN RR CO.	0	1	0
49 UP UNION PACIFIC RR CO.	2	3	133
50 WP WESTERN PACIFIC RR CO.	0	1	6
51 ALS ALTON & SOUTHERN RR	1	0	12
52 BRC BELT RR CO. OF CHICAGO	1	0	27
53 IHB INDIANA HARBOR BELT RR CO.	2	1	60
54 TRRA TERMINAL RR ASSN. OF ST. LOUIS	1	1	35
55 URR UNION RR CO.	1	0	71
56 YS YOUNGSTOWN & SOUTHERN RWY CO.	1	0	0
TOTAL	79	133	3594

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Table J-2 (Option 2)

CASH FLOW ANALYSIS BASED ON ONAC SOUND EMISSION STANDARDS MODEL (CABOOSES)

RAILROAD NAME			NOISE SOURCE RETARDERS	 LOAD CELL TEST SITES	 SWITCHERS
1	BO	BALTIMORE & OHIO RR CO.	5	0	81
2	BAR	BANGOR & AROOSTOOK RR CO.	0	0	2
3	BLE	BESSEMER & LAKE ERIE RR CO.	0	1	0
4	BM	BOSTON & MAINE CORP.	1	1	38
5	CP	CANADIAN PACIFIC (IN MAINE)	0	0	1
6	CV	CENTRAL VERMONT RWY CO.	0	0	1
7	CO	CHESAPEAKE & OHIO RWY CO.	4	11	64
8	CIM	CHICAGO & ILLINOIS MIDLAND RWY CO.	0	0	4
9	CR	CONRAIL	23	14	1255
10	DH	DELAWARE & HUDSON RWY CO.	0	1	25
11	DTS	DETROIT & TOLEDO SHORELINE RR CO.	1	0	0
12	DTI	DETROIT, TOLEDO & IRONTON RR CO.	1	0	13
13	EJE	ELGIN, JOLIET & EASTERN RWY CO.	1	2	54
14	GTW	GRAND TRUNK WESTERN RR CO.	0	1	64
15	ITC	ILLINOIS TERMINAL RR CO.	0	1	1
16	LI	LONG ISLAND RR CO.	1	1	10
17	MEC	MAINE CENTRAL RR CO.	0	2	14
18	NW	NORFOLK & WESTERN RWY CO.	5	7	222
19	PLE	PITTSBURGH & LAKE ERIE RR CO.	0	1	47
20	RFP	RICHMOND, FREDERICKSBURG & POTOMAC RR CO	1	0	10
21	WM	WESTERN MARYLAND RWY CO.	1	0	0
22	CCO	CLINCHFIELD RR CO.	0	1	9
23	FEC	FLORIDA EAST COAST RWY CO.	0	1	9
24	GA	GEORGIA RR CO.	0	0	5
25	ICG	ILLINOIS CENTRAL GULF RR CO.	3	7	116
26	LN	LOUISVILLE & NASHVILLE RR CO.	3	2	107
27	SCL	SEABOARD COAST LINE RR CO.	2	5	112
28	SOU	SOUTHERN RY. SYSTEM	6	2	130
29	ATSF	ATCHISON, TOPEKA & SANTA FE RWY CO.	3	5	95
30	BN	BURLINGTON NORTHERN CO.	7	13	376
31	CNW	CHICAGO & NORTHWESTERN TRANSP. CO.	1	7	99
32	MILW	CHICAGO, MILW., ST. PAUL & PACIFIC RR CO	2	14	141
33	RI	CHICAGO, ROCK ISLAND & PACIFIC RR CO.	1	5	107
34	CS	COLORADO & SOUTHERN RWY CO.	0	0	9
35	DRGW	DENVER & RIO GRANDE WESTERN RR CO.	1	1	28
36	DMIR	DULUTH, MISSABE & IRON RANGE RWY CO.	0	1	18
37	DWP	DULUTH, WINNIPEG & PACIFIC RWY	0	0	0
38	FWD	FORT WORTH & DENVER RWY CO.	0	1	4
39	KCS	KANSAS CITY SOUTHERN RWY CO.	0	2	66
40	MKT	MISSOURI-KANSAS-TEXAS RR CO.	0	1	35
41	MP	MISSOURI PACIFIC RR CO.	2	4	240
42	NWP	NORTHWESTERN PACIFIC RR CO.	0	0	7
43	SLSF	ST. LOUIS-SAN FRANCISCO RWY CO.	1	1	67
44	SSW	ST. LOUIS SOUTHWESTERN RWY CO.	1	0	50
45	SOO	SOO LINE RR CO.	0	2	33
46	SP	SOUTHERN PACIFIC CO.	6	15	384
47	TM	TEXAS MEXICAN RWY CO.	0	0	0
48	TPW	TOLEDO, PEORIA & WESTERN RR CO	0	1	0
49	UP	UNION PACIFIC RR CO.	3	3	170
50	WP	WESTERN PACIFIC RR CO.	0	1	7
51	ALS	ALTON & SOUTHERN RR	1	0	15
52	BRC	BELT RR CO. OF CHICAGO	1	0	35
53	IHB	INDIANA HARBOR BELT RR CO.	2	1	77
54	TRRA	TERMINAL RR ASSN. OF ST. LOUIS	1	1	45
55	URR	UNION RR CO.	1	0	91
56	YS	YOUNGSTOWN & SOUTHERN RWY CO.	1	0	0
TOTAL			93	140	4601

Table J-3A

1979 ESTIMATES OF AVERAGE CAPITAL EXPENDITURES AND ASSOCIATED USEFUL LIVES OF NOISE ABATEMENT EQUIPMENT
($000s)

Reg Level		NOISE SOURCE					
		Retarders		Load Cells		Switchers	
	Fix	Cap Exp	Life	Cap Exp	Life	Cap Exp	Life
1	1	348.6	10				
	2			97.5	10		
	3					7.92	4

Table J-3B

1979 ESTIMATES OF AVERAGE O&M COSTS OF NOISE NOISE ABATEMENT EQUIPMENT
($000s)

Reg Level	NOISE SOURCE		
	Retarders	Load Cells	Switchers
1	9.60	7.30	1.73

Table J-3C

1979 ESTIMATES OF OUT-OF-SERVICE COST*
($000s)

Switcher Engines Only	2.8

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*Cost applied to each switcher engine.

Table J-4 (Option 1)

PRESENT VALUE FACTORS

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INFLATION FACTOR=  6%
DISCOUNT FACTOR = 10%


1979  1.000000
1980  0.963636
1981  0.928595
1982  0.894828
1983  0.862289
1984  0.830933
1985  0.800717
1986  0.771600
1987  0.743541
1988  0.716504
1989  0.690449
1990  0.665342
1991  0.641147
1992  0.617833
1993  0.595366
1994  0.573716
1995  0.552854
1996  0.532750
1997  0.513377
1998  0.494709
1999  0.476720

PRESENT VALUE FOR A TWENTY YEAR ANNUITY= 13.866940
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Table J-4 (Option 2)

PRESENT VALUE FACTORS

INFLATION FACTOR= 6%
DISCOUNT FACTOR = 10%

1979	1.000000
1980	0.963636
1981	0.928595
1982	0.894828
1983	0.862289
1984	0.830933
1985	0.800717
1986	0.771600
1987	0.743541
1988	0.716504
1989	0.690449
1990	0.665342
1991	0.641147
1992	0.617833
1993	0.595366
1994	0.573716
1995	0.552854
1996	0.532750
1997	0.513377
1998	0.494709
1999	0.476720

PRESENT VALUE FOR A TWENTY YEAR ANNUITY= 13.866940

Table J-5 (Option 1)

CASH FLOW SUMMARY BEFORE ABATEMENT PRESENT VALUE AT JANUARY 1, 1980 (DOLLARS IN THOUSANDS)

RAILROAD	PRESENT VALUE OF FUTURE CASH FLOWS	AVERAGE NET INVESTMENT	NET PRESENT VALUE FUTURE CASH FLOWS
BALTIMORE & OHIO RR CO.	643733.	689953.	-46219.*
BANGOR & AROOSTOOK RR CO.	8808.	37523.	-28715.*
BESSEMER & LAKE ERIE RR CO.	177622.	92804.	84818.
BOSTON & MAINE CORP.	-85635.*	56447.	-142082.*
CANADIAN PACIFIC (IN MAINE)	0.*	2256.	-2256.*
CENTRAL VERMONT RWY CO.	9226.	-9143.*	N/A
CHESAPEAKE & OHIO RWY CO.	612208.	650072.	-37784.*
CHICAGO & ILLINOIS MIDLAND RWY CO.	22490.	18354.	4136.
CONRAIL	-8082216.*	-73919.*	N/A
DELAWARE & HUDSON RWY CO.	-61525.*	37313.	-98838.*
DETROIT & TOLEDO SHORELINE RR CO.	11775.	11301.	475.
DETROIT, TOLEDO & IRONTON RR CO.	-22915.*	50863.	-73778.*
ELGIN, JOLIET & EASTERN RWY CO.	183573.	74217.	109356.
GRAND TRUNK WESTERN RR CO.	-43614.*	-115541.*	N/A
ILLINOIS TERMINAL RR CO.	3610.	11815.	-8205.*
LONG ISLAND RR CO.	-1404094.*	114901.	-1518995.*
MAINE CENTRAL RR CO.	24988.	40436.	-15448.*
NORFOLK & WESTERN RWY CO.	1646700.	1100372.	546328.
PITTSBURGH & LAKE ERIE RR CO.	111525.	172453.	-60928.*
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	129464.	77387.	52077.
WESTERN MARYLAND RWY CO.	74935.	86838.	-11903.*
CLINCHFIELD RR CO.	0.*	0.*	N/A
FLORIDA EAST COAST RWY CO.	114210.	93378.	20832.
GEORGIA RR CO.	0.*	0.*	N/A
ILLINOIS CENTRAL GULF RR CO.	211894.	688395.	-476501.*
LOUISVILLE & NASHVILLE RR CO.	280082.	530529.	-250446.*
SEABOARD COAST LINE RR CO.	832553.	1103373.	-270820.*
SOUTHERN RY. SYSTEM	1253665.	996151.	257514.
ATCHISON, TOPEKA & SANTA FE RWY CO.	1132298.	1364400.	-232102.*
BURLINGTON NORTHERN CO.	911217.	1751140.	-839923.*
CHICAGO & NORTHWESTERN TRANSP. CO.	-52165.*	21330.	-73495.*
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-355567.*	297168.	-652735.*
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-344808.*	156830.	-501638.*
COLORADO & SOUTHERN RWY CO.	27766.	72626.	-44860.*
DENVER & RIO GRANDE WESTERN RR CO.	277075.	198502.	78574.
DULUTH, MISSABE & IRON RANGE RWY CO.	97928.	90448.	7481.
DULUTH, WINNIPEG & PACIFIC RWY	77035.	15828.	61207.
FORT WORTH & DENVER RWY CO.	14914.	33648.	-18734.*
KANSAS CITY SOUTHERN RWY CO.	92511.	124139.	-31628.*
MISSOURI-KANSAS-TEXAS RR CO.	-63407.*	-24145.*	N/A
MISSOURI PACIFIC RR CO.	982706.	524344.	458362.
NORTHWESTERN PACIFIC RR CO.	-22763.*	-20098.*	N/A
ST. LOUIS-SAN FRANCISCO RWY CO.	203641.	214026.	-10385.*
ST. LOUIS SOUTHWESTERN RWY CO.	544779.	297476.	247303.
SOO LINE RR CO.	264059.	161966.	102093.
SOUTHERN PACIFIC CO.	1069674.	1507845.	-438171.*
TEXAS MEXICAN RWY CO.	13479.	4084.	9395.
TOLEDO, PEORIA & WESTERN RR CO.	4153.	9915.	-5762.*
UNION PACIFIC RR CO.	1779736.	2514674.	-734938.*
WESTERN PACIFIC RR CO.	-214293.*	108396.	-322689.*
ALTON & SOUTHERN RR	33260.	20260.	13000.
BELT RR CO. OF CHICAGO	592.	5972.	-5380.*
INDIANA HARBOR BELT RR CO.	-5140.*	14928.	-20068.*
TERMINAL RR ASSN. OF ST. LOUIS	-37249.*	1030.	-38279.*
UNION RR CO.	57823.	47836.	9987.
YOUNGSTOWN & SOUTHERN RWY CO.	-1095107.*	-14804.*	N/A
TOTAL	2047214.	16038271.	-4950757.

* - VALUE LESS THAN OR EQUAL TO ZERO

Table J-5 (Option 2)

CASH FLOW SUMMARY BEFORE ABATEMENT PRESENT VALUE AT JANUARY 1, 1980 (DOLLARS IN THOUSANDS)

RAILROAD	PRESENT VALUE OF FUTURE CASH FLOWS	AVERAGE NET INVESTMENT	NET PRESENT VALUE FUTURE CASH FLOWS
BALTIMORE & OHIO RR CO.	643733.	689953.	-46219.*
BANGOR & AROOSTOOK RR CO.	8808.	37523.	-28715.*
BESSEMER & LAKE ERIE RR CO.	177622.	92804.	84818.
BOSTON & MAINE CORP.	-85635.*	56447.	-142082.*
CANADIAN PACIFIC (IN MAINE)	0.*	2256.	-2256.*
CENTRAL VERMONT RWY CO.	9226.	-9143.*	N/A
CHESAPEAKE & OHIO RWY CO.	612288.	650072.	-37784.*
CHICAGO & ILLINOIS MIDLAND RWY CO.	22490.	18354.	4136.
CONRAIL	-8082216.*	-73919.*	N/A
DELAWARE & HUDSON RWY CO.	-61525.*	37313.	-98838.*
DETROIT & TOLEDO SHORELINE RR CO.	11775.	11301.	475.
DETROIT, TOLEDO & IRONTON RR CO.	-22915.*	50863.	-73778.*
ELGIN, JOLIET & EASTERN RWY CO.	183573.	74217.	109356.
GRAND TRUNK WESTERN RR CO.	-43614.*	-115541.*	N/A
ILLINOIS TERMINAL RR CO.	3610.	11815.	-8205.*
LONG ISLAND RR CO.	-1404094.*	114901.	-1518995.*
MAINE CENTRAL RR CO.	24988.	40436.	-15448.*
NORFOLK & WESTERN RWY CO.	1646700.	1100372.	546328.
PITTSBURGH & LAKE ERIE RR CO.	111525.	172453.	-60928.*
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	129464.	77387.	52077.
WESTERN MARYLAND RWY CO.	74935.	86838.	-11903.*
CLINCHFIELD RR CO.	0.*	0.*	N/A
FLORIDA EAST COAST RWY CO.	114210.	93378.	20832.
GEORGIA RR CO.	0.*	0.*	N/A
ILLINOIS CENTRAL GULF RR CO.	211894.	688395.	-476501.*
LOUISVILLE & NASHVILLE RR CO.	280082.	530529.	-250446.*
SEABOARD COAST LINE RR CO.	832553.	1103373.	-270820.*
SOUTHERN RY. SYSTEM	1253665.	996151.	257514.
ATCHISON, TOPEKA & SANTA FE RWY CO.	1132298.	1364400.	-232102.*
BURLINGTON NORTHERN CO.	911217.	1751140.	-839923.*
CHICAGO & NORTHWESTERN TRANSP. CO.	-52165.*	21330.	-73495.*
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-355567.*	297168.	-652735.*
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-344808.*	156830.	-501638.*
COLORADO & SOUTHERN RWY CO.	27766.	72626.	-44860.*
DENVER & RIO GRANDE WESTERN RR CO.	277075.	198502.	78574.
DULUTH, MISSABE & IRON RANGE RWY CO.	97920.	90448.	7481.
DULUTH, WINNIPEG & PACIFIC RWY	77035.	15828.	61207.
FORT WORTH & DENVER RWY CO.	14914.	33648.	-18734.*
KANSAS CITY SOUTHERN RWY CO.	92511.	124139.	-31628.*
MISSOURI-KANSAS-TEXAS RR CO.	-63407.*	-24145.*	N/A
MISSOURI PACIFIC RR CO.	982706.	524344.	458362.
NORTHWESTERN PACIFIC RR CO.	-22763.*	-20098.*	N/A
ST. LOUIS-SAN FRANCISCO RWY CO.	203641.	214026.	-10385.*
ST. LOUIS SOUTHWESTERN RWY CO.	544779.	297476.	247303.
SOO LINE RR CO.	264059.	161966.	102093.
SOUTHERN PACIFIC CO.	1069674.	1507845.	-438171.*
TEXAS MEXICAN RWY CO.	13479.	4084.	9395.
TOLEDO, PEORIA & WESTERN RR CO.	4153.	9915.	-5762.*
UNION PACIFIC RR CO.	1779736.	2514674.	-734938.*
WESTERN PACIFIC RR CO.	-214293.*	108396.	-322689.*
ALTON & SOUTHERN RR	33260.	20260.	13000.
BELT RR CO. OF CHICAGO	592.	5972.	-5380.*
INDIANA HARBOR BELT RR CO.	-5140.*	14928.	-20068.*
TERMINAL RR ASSN. OF ST. LOUIS	-37249.*	1030.	-38279.*
UNION RR CO.	57823.	47836.	9987.
YOUNGSTOWN & SOUTHERN RWY CO.	-1095187.*	-14804.*	N/A
TOTAL	2047214.	16038271.	-4950757.

* - VALUE LESS THAN OR EQUAL TO ZERO

Table J-6 (Option 1)

CAPITAL EXPENDITURE SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS) REPLACEMENT ASSUMPTION APPLIED

RAILROAD NAME	NOISE SOURCE			
	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	1558.	0.	499.	2057.
BANGOR & AROOSTOOK RR CO.	0.	0.	16.	16.
BESSEMER & LAKE ERIE RR CO.	0.	183.	0.	183.
BOSTON & MAINE CORP.	389.	183.	238.	810.
CANADIAN PACIFIC (IN MAINE)	0.	0.	8.	8.
CENTRAL VERMONT RWY CO.	0.	0.	8.	8.
CHESAPEAKE & OHIO RWY CO.	1168.	1830.	396.	3394.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	24.	24.
CONRAIL	7399.	2561.	7762.	17722.
DELAWARE & HUDSON RWY CO.	0.	183.	150.	333.
DETROIT & TOLEDO SHORELINE RR CO.	389.	0.	0.	389.
DETROIT, TOLEDO & IRONTON RR CO.	389.	0.	79.	469.
ELGIN, JOLIET & EASTERN RWY CO.	389.	183.	333.	905.
GRAND TRUNK WESTERN RR CO.	0.	183.	396.	579.
ILLINOIS TERMINAL RR CO.	0.	183.	8.	191.
LONG ISLAND RR CO.	389.	183.	63.	636.
MAINE CENTRAL RR CO.	0.	183.	87.	270.
NORFOLK & WESTERN RWY CO.	1558.	1281.	1370.	4209.
PITTSBURGH & LAKE ERIE RR CO.	0.	183.	293.	476.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	389.	0.	63.	453.
WESTERN MARYLAND RWY CO.	389.	0.	0.	389.
CLINCHFIELD RR CO.	0.	183.	55.	238.
FLORIDA EAST COAST RWY CO.	0.	183.	55.	238.
GEORGIA RR CO.	0.	0.	32.	32.
ILLINOIS CENTRAL GULF RR CO.	779.	1281.	721.	2780.
LOUISVILLE & NASHVILLE RR CO.	779.	183.	665.	1627.
SEABOARD COAST LINE RR CO.	779.	732.	697.	2208.
SOUTHERN RY. SYSTEM	1947.	366.	855.	3168.
ATCHISON, TOPEKA & SANTA FE RWY CO.	779.	915.	586.	2280.
BURLINGTON NORTHERN CO.	2337.	2379.	2328.	7044.
CHICAGO & NORTHWESTERN TRANSP. CO.	389.	1281.	610.	2280.
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	779.	2561.	871.	4212.
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	389.	915.	657.	1962.
COLORADO & SOUTHERN RWY CO.	0.	0.	55.	55.
DENVER & RIO GRANDE WESTERN RR CO.	389.	183.	174.	747.
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	183.	111.	294.
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	183.	24.	207.
KANSAS CITY SOUTHERN RWY CO.	0.	183.	404.	587.
MISSOURI-KANSAS-TEXAS RR CO.	0.	183.	214.	397.
MISSOURI PACIFIC RR CO.	779.	732.	1489.	3000.
NORTHWESTERN PACIFIC RR CO.	0.	0.	40.	40.
ST. LOUIS-SAN FRANCISCO RWY CO.	389.	183.	412.	984.
ST. LOUIS SOUTHWESTERN RWY CO.	389.	0.	309.	698.
SOO LINE RR CO.	0.	183.	206.	389.
SOUTHERN PACIFIC CO.	1947.	2744.	2376.	7068.
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	183.	0.	183.
UNION PACIFIC RR CO.	779.	549.	1053.	2381.
WESTERN PACIFIC RR CO.	0.	183.	48.	230.
ALTON & SOUTHERN RR	389.	0.	95.	484.
BELT RR CO. OF CHICAGO	389.	0.	214.	603.
INDIANA HARBOR BELT RR CO.	779.	183.	475.	1437.
TERMINAL RR ASSN. OF ST. LOUIS	389.	183.	277.	850.
UNION RR CO.	389.	0.	562.	952.
YOUNGSTOWN & SOUTHERN RWY CO.	389.	0.	0.	389.
TOTAL	30764.	24334.	28464.	83562.

Table J-6 (Option 2)

CAPITAL EXPENDITURE SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS(REPLACEMENT ASSUMPTION APPLIED

	NOISE SOURCE			
RAILROAD NAME	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	1947.	0.	642.	2589.
BANGOR & AROOSTOCK RR CO.	0.	0.	16.	16.
BESSEMER & LAKE ERIE RR CO.	0.	183.	0.	183.
BOSTON & MAINE CORP.	389.	183.	301.	873.
CANADIAN PACIFIC (IN MAINE)	0.	0.	8.	8.
CENTRAL VERMONT RWY CO.	0.	0.	8.	8.
CHESAPEAKE & OHIO RWY CO.	1558.	2013.	507.	4077.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	32.	32.
CONRAIL	8957.	2561.	9940.	21458.
DELAWARE & HUDSON RWY CO.	0.	183.	198.	381.
DETROIT & TOLEDO SHORELINE RR CO.	389.	0.	0.	389.
DETROIT, TOLEDO & IRONTON RR CO.	389.	0.	103.	492.
ELGIN, JOLIET & EASTERN RWY CO.	389.	366.	428.	1183.
GRAND TRUNK WESTERN RR CO.	0.	183.	507.	690.
ILLINOIS TERMINAL RR CO.	0.	183.	8.	191.
LONG ISLAND RR CO.	389.	183.	79.	652.
MAINE CENTRAL RR CO.	0.	366.	111.	477.
NORFOLK & WESTERN RWY CO.	1947.	1281.	1758.	4986.
PITTSBURGH & LAKE ERIE RR CO.	0.	183.	372.	555.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	389.	0.	79.	469.
WESTERN MARYLAND RWY CO.	389.	0.	0.	389.
CLINCHFIELD RR CO.	0.	183.	71.	254.
FLORIDA EAST COAST RWY CO.	0.	183.	71.	254.
GEORGIA RR CO.	0.	0.	40.	40.
ILLINOIS CENTRAL GULF RR CO.	1168.	1281.	919.	3368.
LOUISVILLE & NASHVILLE RR CO.	1168.	366.	847.	2382.
SEABOARD COAST LINE RR CO.	779.	915.	887.	2581.
SOUTHERN RY. SYSTEM	2337.	366.	1093.	3795.
ATCHISON, TOPEKA & SANTA FE RWY CO.	1168.	915.	752.	2835.
BURLINGTON NORTHERN CO.	2726.	2379.	2978.	8082.
CHICAGO & NORTHWESTERN TRANSP. CO.	389.	1281.	784.	2454.
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	779.	2561.	1117.	4457.
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	389.	915.	847.	2152.
COLORADO & SOUTHERN RWY CO.	0.	0.	71.	71.
DENVER & RIO GRANDE WESTERN RR CO.	389.	183.	222.	794.
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	183.	143.	326.
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	183.	32.	215.
KANSAS CITY SOUTHERN RWY CO.	0.	366.	523.	889.
MISSOURI-KANSAS-TEXAS RR CO.	0.	183.	277.	460.
MISSOURI PACIFIC RR CO.	779.	732.	1901.	3411.
NORTHWESTERN PACIFIC RR CO.	0.	0.	55.	55.
ST. LOUIS-SAN FRANCISCO RWY CO.	389.	183.	531.	1103.
ST. LOUIS SOUTHWESTERN RWY CO.	389.	0.	396.	785.
SOO LINE RR CO.	0.	366.	261.	627.
SOUTHERN PACIFIC CO.	2337.	2744.	3041.	8122.
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	183.	0.	183.
UNION PACIFIC RR CO.	1168.	549.	1346.	3064.
WESTERN PACIFIC RR CO.	0.	183.	55.	238.
ALTON & SOUTHERN RR	389.	0.	119.	508.
BELT RR CO. OF CHICAGO	389.	0.	277.	667.
INDIANA HARBOR BELT RR CO.	779.	183.	610.	1572.
TERMINAL RR ASSN. OF ST. LOUIS	389.	183.	356.	929.
UNION RR CO.	389.	0.	721.	1110.
YOUNGSTOWN & SOUTHERN RWY CO.	389.	0.	0.	389.
TOTAL	36216.	25615.	36440.	98270.

Table J-7 (Option 1)

PRESENT VALUE OF CAPITAL EXPENDITURE SUMMARY AT JANUARY 1, 1980 (DOLLARS IN THOUSANDS) REPLACEMENT ASSUMPTION APPLIED

	NOISE SOURCE			
RAILROAD NAME	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CC.	1300.	0.	446.	1746.
BANGOR & AROOSTOCK RR CO.	0.	0.	14.	14.
BESSEMER & LAKE ERIE RR CO.	0.	135.	0.	135.
BOSTON & MAINE CORP.	325.	135.	213.	672.
CANADIAN PACIFIC (IN MAINE)	0.	0.	7.	7.
CENTRAL VERMONT RWY CO.	0.	0.	7.	7.
CHESAPEAKE & OHIO RWY CO.	975.	1350.	354.	2679.
CHICAGO & ILLINOIS MIDLAND RWY CC.	0.	0.	21.	21.
CONRAIL	6173.	1889.	6945.	15008.
DELAWARE & HUDSON RWY CO.	0.	135.	135.	270.
DETROIT & TOLEDO SHORELINE RR CO.	325.	0.	0.	325.
DETROIT, TOLEDO & IRONTON RR CO.	325.	0.	71.	396.
ELGIN, JOLIET & EASTERN RWY CO.	325.	135.	290.	750.
GRAND TRUNK WESTERN RR CO.	0.	135.	354.	489.
ILLINOIS TERMINAL RR CO.	0.	135.	7.	142.
LONG ISLAND RR CO.	325.	135.	57.	517.
MAINE CENTRAL RR CO.	0.	135.	78.	213.
NORFOLK & WESTERN RWY CO.	1300.	945.	1226.	3470.
PITTSBURGH & LAKE ERIE RR CO.	0.	135.	262.	397.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	325.	0.	57.	382.
WESTERN MARYLAND RWY CO.	325.	0.	0.	325.
CLINCHFIELD RR CO.	0.	135.	50.	185.
FLORIDA EAST COAST RWY CO.	0.	135.	50.	185.
GEORGIA RR CO.	0.	0.	28.	28.
ILLINOIS CENTRAL GULF RR CO.	650.	945.	645.	2239.
LOUISVILLE & NASHVILLE RR CO.	650.	135.	595.	1380.
SEABOARD COAST LINE RR CO.	650.	540.	624.	1813.
SOUTHERN RY. SYSTEM	1624.	270.	765.	2660.
ATCHISON, TOPEKA & SANTA FE RWY CO.	650.	675.	524.	1849.
BURLINGTON NORTHERN CO.	1949.	1754.	2084.	5787.
CHICAGO & NORTHWESTERN TRANSP. CO.	325.	945.	546.	1815.
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	650.	1889.	780.	3319.
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	325.	675.	508.	1508.
COLORADO & SOUTHERN RWY CO.	0.	0.	50.	50.
DENVER & RIO GRANDE WESTERN RR CC.	325.	135.	156.	616.
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	135.	99.	234.
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	135.	21.	156.
KANSAS CITY SOUTHERN RWY CO.	0.	135.	361.	496.
MISSOURI-KANSAS-TEXAS RR CO.	0.	135.	191.	326.
MISSOURI PACIFIC RR CO.	650.	540.	1332.	2522.
NORTHWESTERN PACIFIC RR CO.	0.	0.	35.	35.
ST. LOUIS-SAN FRANCISCO RWY CO.	325.	135.	369.	828.
ST. LOUIS SOUTHWESTERN RWY CO.	325.	0.	276.	601.
SOO LINE RR CO.	0.	135.	184.	319.
SOUTHERN PACIFIC CO.	1624.	2024.	2126.	5775.
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	135.	0.	135.
UNION PACIFIC RR CO.	650.	405.	943.	1997.
WESTERN PACIFIC RR CO.	0.	135.	43.	177.
ALTON & SOUTHERN RR	325.	0.	85.	410.
BELT RR CO. OF CHICAGO	325.	0.	191.	516.
INDIANA HARBOR BELT RR CO.	650.	135.	425.	1210.
TERMINAL RR ASSN. OF ST. LOUIS	325.	135.	248.	708.
UNION RR CO.	325.	0.	503.	828.
YOUNGSTOWN & SOUTHERN RWY CO.	325.	0.	0.	325.
TOTAL	25667.	17949.	25470.	69086.

Table J-7 (Option 2)

PRESENT VALUE OF CAPITAL EXPENDITURE SUMMARY AT JANUARY 1, 1980
(DOLLARS IN THOUSANDS) REPLACEMENT ASSUMPTION APPLIED

RAILROAD NAME	NOISE SOURCE RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	1624.	0.	530	2154.
BANGOR & AROOSTOOK RR CO.	0.	0.	16.	16.
BESSEMER & LAKE ERIE RR CO.	0.	135.	0.	135.
BOSTON & MAINE CORP.	325.	135.	260.	720.
CANADIAN PACIFIC (IN MAINE)	0.	0.	7.	7.
CENTRAL VERMONT RWY CO.	0.	0.	7.	7.
CHESAPEAKE & OHIO RWY CO.	1300.	1600.	454.	[illegible]
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	20.	20.
CONRAIL	2673.	[illegible]	6094.	10236.
DELAWARE & HUDSON RWY CO.	0.	135.	177.	312.
DETROIT & TOLEDO SHORELINE RR CO.	325.	0.	0.	325.
DETROIT, TOLEDO & IRONTON RR CO.	325.	0.	92.	417.
ELGIN, JOLIET & EASTERN RWY CO.	325.	270.	335.	930.
GRAND TRUNK WESTERN RR CO.	0.	135.	454.	589.
ILLINOIS TERMINAL RR CO.	0.	135.	7.	142.
LONG ISLAND RR CO.	325.	135.	71.	531.
MAINE CENTRAL RR CO.	0.	270.	90.	360.
NORFOLK & WESTERN RWY CO.	4624.	985.	1533.	7142.
PITTSBURGH & LAKE ERIE RR CO.	0.	135.	333.	468.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	325.	0.	71.	396.
WESTERN MARYLAND RWY CO.	325.	0.	0.	325.
CLINCHFIELD RR CO.	0.	135.	64.	199.
FLORIDA EAST COAST RWY CO.	0.	135.	64.	199.
GEORGIA RR CO.	0.	0.	25.	25.
ILLINOIS CENTRAL GULF RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
LOUISVILLE & NASHVILLE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
SEABOARD COAST LINE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	[illegible]	[illegible]	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
BURLINGTON NORTHERN INC.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
COLORADO & SOUTHERN RWY CO.	0.	0.	[illegible]	[illegible]
DENVER & RIO GRANDE WESTERN RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO	0.	[illegible]	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	[illegible]	[illegible]	[illegible]
KANSAS CITY SOUTHERN RWY CO.	0.	[illegible]	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	[illegible]	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
NORTHWESTERN PACIFIC RR CO.	0.	0.	[illegible]	[illegible]
ST. LOUIS-SAN FRANCISCO RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	[illegible]	0.	[illegible]	[illegible]
SOO LINE RR CO.	0.	[illegible]	[illegible]	[illegible]
SOUTHERN PACIFIC CO.	[illegible]	[illegible]	[illegible]	[illegible]
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	[illegible]	0.	[illegible]
UNION PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
WESTERN PACIFIC RR CO.	0.	[illegible]	[illegible]	[illegible]
ALTON & SOUTHERN RR	[illegible]	0.	[illegible]	[illegible]
BELT RY CO. OF CHICAGO	[illegible]	0.	[illegible]	[illegible]
INDIANA HARBOR BELT RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
TERMINAL RR ASSN. OF ST. LOUIS	[illegible]	[illegible]	[illegible]	[illegible]
UNION RR CO.	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]

Table J-8 (Option 1)

INITIAL CAPITAL EXPENDITURE SUMMARY
(DOLLARS IN THOUSANDS)

	NOISE SOURCE			
RAILROAD NAME	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	1394.	0.	499.	1892.
BANGOR & AROOSTOCK RR CO.	0.	0.	16.	16.
BESSEMER & LAKE ERIE RR CO.	0.	90.	0.	90.
BOSTON & MAINE CORP.	369.	90.	230.	689.
CANADIAN PACIFIC (IN MAINE)	0.	0.	0.	0.
CENTRAL VERMONT RWY CO.	0.	0.	0.	0.
CHESAPEAKE & OHIO RWY CO.	1246.	975.	396.	2617.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	24.	24.
CONRAIL	6623.	1365.	7762.	15750.
DELAWARE & HUDSON RWY CO.	0.	90.	150.	240.
DETROIT & TOLEDO SHORELINE RR CO.	369.	0.	0.	369.
DETROIT, TOLEDO & IRONTON RR CO.	369.	0.	59.	428.
ELGIN, JOLIET & EASTERN RWY CO.	369.	90.	320.	779.
GRAND TRUNK WESTERN RR CO.	0.	90.	396.	486.
ILLINOIS TERMINAL RR CO.	0.	90.	0.	105.
LONG ISLAND RR CO.	369.	90.	63.	522.
MAINE CENTRAL RR CO.	0.	90.	87.	177.
NORFOLK & WESTERN RWY CO.	1390.	603.	1370.	3363.
PITTSBURGH & LAKE ERIE RR CO.	0.	90.	293.	383.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	369.	0.	63.	432.
WESTERN MARYLAND RWY CO.	369.	0.	0.	369.
CLINCHFIELD RR CO.	0.	90.	55.	145.
FLORIDA EAST COAST RWY CO.	0.	90.	55.	145.
GEORGIA RR CO.	0.	0.	32.	32.
ILLINOIS CENTRAL GULF RR CO.	697.	603.	725.	2025.
LOUISVILLE & NASHVILLE RR CO.	697.	90.	665.	1452.
SEABOARD COAST LINE RR CO.	697.	290.	697.	1684.
SOUTHERN RY. SYSTEM	[illegible]	[illegible]	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
BURLINGTON NORTHERN INC.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.
[illegible]	0.	[illegible]	0.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table J-8 (Option 2)

INITIAL CAPITAL EXPENDITURE SUMMARY
(DOLLARS IN THOUSANDS)

RAILROAD NAME	NOISE SOURCE			
	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
BANGOR & AROOSTOOK RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
BESSEMER & LAKE ERIE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
BOSTON & MAINE CORP.	[illegible]	[illegible]	[illegible]	[illegible]
CANADIAN PACIFIC (IN MAINE)	[illegible]	[illegible]	[illegible]	[illegible]
CENTRAL VERMONT RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHESAPEAKE & OHIO RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & ILLINOIS MIDLAND RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
CONRAIL	[illegible]	[illegible]	[illegible]	[illegible]
DELAWARE & HUDSON RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
DETROIT & TOLEDO SHORELINE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
DETROIT, TOLEDO & IRONTON RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
ELGIN, JOLIET & EASTERN RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
GRAND TRUNK WESTERN RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
ILLINOIS TERMINAL RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
LONG ISLAND RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
MAINE CENTRAL RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
NORFOLK & WESTERN RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
PITTSBURGH & LAKE ERIE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
WESTERN MARYLAND RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
CLINCHFIELD RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
FLORIDA EAST COAST RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
GEORGIA RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
ILLINOIS CENTRAL GULF RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
LOUISVILLE & NASHVILLE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
SEABOARD COAST LINE RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	[illegible]	[illegible]	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
BURLINGTON NORTHERN INC.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]

Table J-9 (Option 1)

OPERATIONS & MAINTENANCE COST SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

	BEFORE TAX				AFTER TAX			
	NOISE SOURCE				NOISE SOURCE			
RAILROAD	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	656.	0.	2919.	3575.	354.	0.	1576.	1930.
BANGOR & AROOSTOOK RR CO.	0.	0.	93.	93.	0.	0.	50.	50.
BESSEMER & LAKE ERIE RR CO.	0.	124.	0.	124.	0.	67.	0.	67.
BOSTON & MAINE CORP.	164.	124.	1390.	1678.	89.	67.	751.	906.
CANADIAN PACIFIC (US RAILS)	0.	0.	46.	46.	0.	0.	25.	25.
CENTRAL VERMONT RWY CO.	0.	0.	46.	46.	0.	0.	25.	25.
CHESAPEAKE & OHIO RWY CO.	492.	1243.	2316.	4051.	266.	671.	1251.	2188.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	139.	139.	0.	0.	75.	75.
CONRAIL	3115.	1740.	45402.	50258.	1682.	940.	24517.	27139.
DELAWARE & HUDSON RWY CO.	0.	124.	880.	1005.	0.	67.	475.	542.
DETROIT & TOLEDO SHORELINE RR CO.	164.	0.	0.	164.	89.	0.	0.	89.
DETROIT, TOLEDO & IRONTON RR CO.	164.	0.	463.	627.	89.	0.	250.	339.
ELGIN, JOLIET & EASTERN RWY CO.	164.	124.	1946.	2230.	89.	67.	1051.	1206.
GRAND TRUNK WESTERN RR CO.	0.	124.	2316.	2441.	0.	67.	1251.	1318.
ILLINOIS TERMINAL RR CO.	0.	124.	46.	171.	0.	67.	25.	92.
LONG ISLAND RR CO.	164.	124.	371.	659.	89.	67.	200.	356.
MAINE CENTRAL RR CO.	0.	124.	510.	634.	0.	67.	275.	342.
NORFOLK & WESTERN RWY CO.	656.	870.	8015.	9541.	354.	470.	4328.	5152.
PITTSBURGH & LAKE ERIE RR CO.	0.	124.	1716.	1840.	0.	67.	926.	993.
RICHMOND, FREDERICKSBURG & POTOMAC R	164.	0.	371.	535.	89.	0.	200.	289.
WESTERN MARYLAND RWY CO.	164.	0.	0.	164.	89.	0.	0.	89.
CLINCHFIELD RR CO.	0.	124.	324.	449.	0.	67.	175.	242.
FLORIDA EAST COAST RWY CO.	0.	124.	324.	449.	0.	67.	175.	242.
GEORGIA RR CO.	0.	0.	185.	185.	0.	0.	100.	100.
ILLINOIS CENTRAL GULF RR CO.	328.	870.	4216.	5414.	177.	470.	2277.	2924.
LOUISVILLE & NASHVILLE RR CO.	328.	124.	3892.	4344.	177.	67.	2102.	2346.
SEABOARD COAST LINE RR CO.	328.	497.	4077.	4902.	177.	268.	2202.	2647.
SOUTHERN CO. SYSTEM	820.	249.	5003.	6072.	443.	134.	2702.	3279.
ATCHISON, TOPEKA & SANTA FE RWY C.	328.	622.	3428.	4378.	177.	336.	1851.	2364.
BURLINGTON NORTHERN CO.	984.	1616.	13621.	16220.	531.	873.	7355.	8759.
CHICAGO & NORTHWESTERN TRANSP. C.	164.	870.	3567.	4601.	89.	470.	1926.	2485.
CHICAGO, MILW., ST. PAUL & PACIFIC R	328.	1740.	5096.	7164.	177.	940.	2752.	3869.
CHICAGO, ROCK ISLAND & PACIFIC R CO	164.	622.	3845.	4631.	89.	336.	2076.	2501.
COLORADO & SOUTHERN RWY CO.	0.	0.	324.	324.	0.	0.	175.	175.
DENVER & RIO GRANDE WESTERN RR C.	164.	124.	1019.	1307.	89.	67.	550.	706.
DULUTH, MISSABE & IRON RANGE RAILW.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
KANSAS CITY SOUTHERN RWY CO.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	328.	[illegible]	[illegible]	[illegible]	177.	[illegible]	[illegible]	[illegible]
NORTHWESTERN PACIFIC RR CO.	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]	[illegible]
ST. LOUIS-SAN FRANCISCO RWY CO.	[illegible]	124.	[illegible]	[illegible]	[illegible]	67.	[illegible]	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SOO LINE RR CO.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
SOUTHERN PACIFIC CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	124.	0.	124.	0.	67.	0.	67.
UNION PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WESTERN PACIFIC RR CO.	0.	124.	[illegible]	[illegible]	0.	67.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	124.	[illegible]	[illegible]	[illegible]	67.	[illegible]	[illegible]
[illegible]	[illegible]	124.	[illegible]	[illegible]	[illegible]	67.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table J-9 (Option 2)

OPERATIONS & MAINTENANCE COST SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

RAILROAD	BEFORE TAX NOISE SOURCE RETARDERS	 LOAD CELL TEST SITES	 SWITCHERS	 TOTAL	AFTER TAX NOISE SOURCE RETARDERS	 LOAD CELL TEST SITES	 SWITCHERS	 TOTAL
BALTIMORE & OHIO RR CO.	820.	0.	3753.	4572.	443.	0.	2026.	2469.
BANGOR & AROOSTOOK RR CO.	0.	0.	93.	93.	0.	0.	50.	50.
BESSEMER & LAKE ERIE RR CO.	0.	120.	0.	120.	0.	67.	0.	67.
BOSTON & MAINE CORP.	164.	120.	1760.	2044.	89.	67.	951.	1106.
CANADIAN PACIFIC (IN MAINE)	0.	0.	46.	46.	0.	0.	25.	25.
CENTRAL VERMONT RWY CO.	0.	0.	46.	46.	0.	0.	25.	25.
CHESAPEAKE & OHIO RWY CO.	656.	1367.	2965.	4988.	356.	730.	1601.	2690.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	185.	185.	0.	0.	100.	100.
CONRAIL	3771.	1740.	58142.	63654.	2036.	940.	31397.	34373.
DELAWARE & HUDSON RWY CO.	0.	120.	1158.	1283.	0.	67.	625.	692.
DETROIT & TOLEDO SHORELINE RR CO.	164.	0.	0.	164.	89.	0.	0.	89.
DETROIT, TOLEDO & IRONTON RR CO.	164.	0.	602.	766.	89.	0.	325.	414.
ELGIN, JOLIET & EASTERN RWY CO.	164.	240.	2502.	2906.	89.	130.	1351.	1570.
GRAND TRUNK WESTERN RR CO.	0.	120.	2965.	3089.	0.	67.	1601.	1668.
ILLINOIS TERMINAL RR CO.	0.	120.	46.	171.	0.	67.	25.	92.
LONG ISLAND RR CO.	164.	120.	463.	752.	89.	67.	250.	406.
MAINE CENTRAL RR CO.	0.	240.	669.	897.	0.	130.	350.	480.
NORFOLK & WESTERN RWY CO.	820.	870.	10205.	11975.	443.	470.	5550.	6466.
PITTSBURGH & LAKE ERIE RR CO.	0.	120.	2177.	2302.	0.	67.	1176.	1243.
RICHMOND, FREDERICKSBURG & POTOMAC R	164.	0.	663.	827.	89.	0.	250.	339.
WESTERN MARYLAND RWY CO.	164.	0.	0.	164.	89.	0.	0.	89.
CLINCHFIELD RR CO.	0.	120.	441.	561.	0.	67.	225.	292.
FLORIDA EAST COAST RWY CO.	0.	120.	441.	561.	0.	67.	225.	292.
GEORGIA RR CO.	0.	0.	232.	232.	0.	0.	125.	125.
ILLINOIS CENTRAL GULF RR CO.	492.	870.	5376.	6738.	266.	470.	2902.	3638.
LOUISVILLE & NASHVILLE RR CO.	492.	240.	[illegible]	[illegible]	266.	130.	[illegible]	[illegible]
SEABOARD COAST LINE RR CO.	328.	622.	[illegible]	[illegible]	177.	336.	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	984.	240.	[illegible]	[illegible]	531.	130.	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	492.	622.	[illegible]	[illegible]	266.	336.	[illegible]	[illegible]
BURLINGTON NORTHERN CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC R	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COLORADO & SOUTHERN RWY CO.	0.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
DENVER & RIO GRANDE WESTERN RR CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
FORT WORTH & DENVER RWY CO.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS CITY SOUTHERN RWY CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	0.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table J-10 (Option 1)

OUT OF SERVICE COST SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

RAILROAD	BEFORE TAX				AFTER TAX			
	NOISE SOURCE				NOISE SOURCE			
	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	388.	0.	176.	564.	210.	0.	95.	305.
BANGOR & AROOSTOOK RR CO.	0.	0.	6.	6.	0.	0.	3.	3.
BESSEMER & LAKE ERIE RR CO.	0.	0.	0.	0.	0.	0.	0.	0.
BOSTON & MAINE CORP.	97.	0.	84.	181.	52.	0.	45.	98.
CANADIAN PACIFIC (IN MAINE)	0.	0.	3.	3.	0.	0.	2.	2.
CENTRAL VERMONT RWY CO.	0.	0.	3.	3.	0.	0.	2.	2.
CHESAPEAKE & OHIO RWY CO.	291.	0.	140.	431.	157.	0.	76.	233.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	9.	9.	0.	0.	5.	5.
CONRAIL	1841.	0.	2766.	4607.	995.	0.	1482.	2477.
DELAWARE & HUDSON RWY CO.	0.	0.	53.	53.	0.	0.	29.	29.
DETROIT & TOLEDO SHORELINE RR CO.	97.	0.	0.	97.	52.	0.	0.	52.
DETROIT, TOLEDO & IRONTON RR CO.	97.	0.	28.	125.	52.	0.	15.	67.
ELGIN, JOLIET & EASTERN RWY CO.	97.	0.	118.	215.	52.	0.	64.	116.
GRAND TRUNK WESTERN RR CO.	0.	0.	140.	140.	0.	0.	76.	76.
ILLINOIS TERMINAL RR CO.	0.	0.	3.	3.	0.	0.	2.	2.
LONG ISLAND RR CO.	97.	0.	22.	119.	52.	0.	12.	64.
MAINE CENTRAL RR CO.	0.	0.	31.	31.	0.	0.	17.	17.
NORFOLK & WESTERN RWY CO.	388.	0.	484.	872.	210.	0.	262.	472.
PITTSBURGH & LAKE ERIE RR CO.	0.	0.	104.	104.	0.	0.	56.	56.
RICHMOND, FREDERICKSBURG & POTOMAC R	97.	0.	22.	119.	52.	0.	12.	64.
[illegible] PORTLAND RWY CO.	97.	0.	0.	97.	52.	0.	0.	52.
CLINCHFIELD RR CO.	0.	0.	20.	20.	0.	0.	11.	11.
FLORIDA EAST COAST RWY CO.	0.	0.	20.	20.	0.	0.	11.	11.
GEORGIA RR CO.	0.	0.	11.	11.	0.	0.	6.	6.
ILLINOIS CENTRAL GULF RR CO.	194.	0.	255.	449.	105.	0.	138.	243.
LOUISVILLE & NASHVILLE RR CO.	[illegible]	0.	235.	[illegible]	[illegible]	0.	[illegible]	[illegible]
SEABOARD COAST LINE RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
BURLINGTON NORTHERN CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC R	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
TOTAL	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]

Table J-10 (Option 2)

OUT OF SERVICE COST SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

	BEFORE TAX				AFTER TAX			
	NOISE SOURCE				NOISE SOURCE			
RAILROAD	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	485.	0.	227.	712.	262.	0.	122.	384.
BANGOR & AROOSTOOK RR CO.	0.	0.	6.	6.	0.	0.	3.	3.
BESSEMER & LAKE ERIE RR CO.	0.	0.	0.	0.	0.	0.	0.	0.
BOSTON & MAINE CORP.	97.	0.	106.	203.	52.	0.	57.	110.
CANADIAN PACIFIC (IN MAINE)	0.	0	3.	3.	0.	0.	2.	2.
CENTRAL VERMONT RWY CO.	0.	0	3.	3.	0.	0.	2.	2.
CHESAPEAKE & OHIO RWY CO.	388.	0	179.	567.	210.	0.	97.	306.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0	11.	11.	0.	0.	6.	6.
CONRAIL	2235.	0.	3510.	5745.	1205.	0.	1898.	3102.
DELAWARE & HUDSON RWY CO.	0.	0.	70.	70.	0.	0.	38.	38.
DETROIT & TOLEDO SHORELINE RR CO.	97.	0.	0.	97.	52.	0.	0.	52.
DETROIT, TOLEDO & IRONTON RR CO.	97.	0.	36.	133.	52.	0.	20.	72.
ELGIN, JOLIET & EASTERN RWY CO.	97.	0.	151.	248.	52.	0.	82.	134.
GRAND TRUNK WESTERN RR CO.	0.	0.	179.	179.	0.	0.	97.	97.
ILLINOIS TERMINAL RR CO.	0.	0.	3.	3.	0.	0.	2.	2.
LONG ISLAND RR CO.	97.	0.	28.	125.	52.	0.	15.	67.
MAINE CENTRAL RR CO.	0.	0.	39.	39.	0.	0.	21.	21.
NORFOLK & WESTERN RWY CO.	485.	0.	622.	1107.	262.	0.	336.	598.
PITTSBURGH & LAKE ERIE RR CO.	0.	0.	132.	132.	0.	0.	71.	71.
RICHMOND, FREDERICKSBURG & POTOMAC R	97.	0.	28.	125.	52.	0.	15.	67.
WESTERN MARYLAND RWY CO.	97.	0.	0.	97.	52.	0.	0.	52.
CLINCHFIELD RR CO.	0.	0.	25.	25.	0.	0.	14.	14.
FLORIDA EAST COAST RWY CO.	0.	0.	25.	25.	0.	0.	14.	14.
GEORGIA RR CO.	0.	0.	16.	16.	0.	0.	8.	8.
ILLINOIS CENTRAL GULF RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
LOUISVILLE & NASHVILLE RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SEABOARD COAST LINE RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
BURLINGTON NORTHERN CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC R	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
COLORADO & SOUTHERN RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
DENVER & RIO GRANDE WESTERN RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
FORT WORTH & DENVER RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
KANSAS CITY SOUTHERN RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
NORTHWESTERN PACIFIC RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
ST. LOUIS-SAN FRANCISCO RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SOO LINE RR CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
TOTAL	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]

Table J-11 (Option 1)

DEPRECIATION EXPENSE SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

	BEFORE TAX				AFTER TAX			
	NOISE SOURCE				NOISE SOURCE			
RAILROAD	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	696.	0.	431.	1127.	320.	0.	198.	518.
BANGOR & AROOSTOOK RR CO.	0.	0.	14.	14.	0.	0.	6.	6.
BESSEMER & LAKE ERIE RR CO.	0.	157.	0.	157.	0.	72.	0.	72.
BOSTON & MAINE CORP.	174.	157.	205.	537.	80.	72.	94.	247.
CANADIAN PACIFIC (IN MAINE)	0.	0.	7.	7	0.	0.	3.	3.
CENTRAL VERMONT RWY CO.	0.	0.	7.	7	0.	0.	3.	3.
CHESAPEAKE & OHIO RWY CO.	522.	1573.	342.	2437	240.	724.	157.	1121.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	21.	21.	0.	0.	9.	9.
CONRAIL	3307.	2203.	6702.	12211.	1521.	1013.	3083.	5617.
DELAWARE & HUDSON RWY CO.	0.	157.	130.	287.	0.	72.	60.	132.
DETROIT & TOLEDO SHORELINE RR CO.	174.	0.	0.	174.	80.	0.	0.	80.
DETROIT, TOLEDO & IRONTON RR CO.	174.	0.	68.	242.	80.	0.	31.	112.
ELGIN, JOLIET & EASTERN RWY CO.	174.	157.	287.	619.	80.	72.	132.	285.
GRAND TRUNK WESTERN RR CO.	0.	157.	342.	499.	0.	72.	157.	230.
ILLINOIS TERMINAL RR CO.	0.	157.	7.	164.	0.	72.	3.	76.
LONG ISLAND RR CO.	174.	157.	55.	386.	80.	72.	25.	178.
MAINE CENTRAL RR CO.	0.	157.	75.	233.	0.	72.	35.	107.
NORFOLK & WESTERN RWY CO.	696.	1101.	1183.	2981.	320.	507.	544.	1371.
PITTSBURGH & LAKE ERIE RR CO.	0.	157.	253.	410.	0.	72.	116.	189.
RICHMOND, FREDERICKSBURG & POTOMAC R	174.	0.	55.	229.	80.	0.	25.	105.
WESTERN MARYLAND RWY CO.	174.	0.	0.	174.	80.	0.	0.	80.
CLINCHFIELD RR CO.	0.	157.	48.	205.	0.	72.	22.	94.
FLORIDA EAST COAST RWY CO.	0.	157.	48.	205.	0.	72.	22.	94.
GEORGIA RR CO.	0.	0.	27.	27.	0.	0.	13.	13.
ILLINOIS CENTRAL GULF RR CO.	348.	1101.	622.	2072.	160.	507.	286.	953.
LOUISVILLE & NASHVILLE RR CO.	348.	157.	570.	1080.	160	72.	260.	497.
SEABOARD COAST LINE RR CO.	348.	629.	602.	1579.	160	289.	277.	726.
SOUTHERN RY. SYSTEM	870.	315.	735.	1923.	400	145.	340.	885.
ATCHISON, TOPEKA & SANTA FE RWY CO.	348.	787.	506.	1641.	160	362.	233.	755.
BURLINGTON NORTHERN CO.	[illegible]	2005.	[illegible]	[illegible]	[illegible]	[illegible]	925.	2306.
CHICAGO & NORTHWESTERN TRANSP. CO.	174.	1101.	[illegible]	[illegible]	80.	507.	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC R	348.	2203.	[illegible]	[illegible]	160.	1013.	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO	174.	787.	560.	1520.	80.	362.	[illegible]	[illegible]
COLORADO & SOUTHERN RWY CO.	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	0.	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table J-11 (Option 2)

DEPRECIATION EXPENSE SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS)

	BEFORE TAX				AFTER TAX			
	NOISE SOURCE				NOISE SOURCE			
RAILROAD	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	870.	0.	554.	1424.	400.	0.	255.	655.
BANGOR & AROOSTOOK RR CO.	0.	0.	14.	14.	0.	0.	6.	6.
BESSEMER & LAKE ERIE RR CO.	0.	157.	0	157.	0.	72.	0.	72.
BOSTON & MAINE CORP.	174.	157.	260	591.	80.	72.	120.	272.
CANADIAN PACIFIC (IN MAINE)	0.	0.	7.	7.	0.	0.	3.	3.
CENTRAL VERMONT RWY CO.	0.	0.	7.	7.	0.	0.	3.	3.
CHESAPEAKE & OHIO RWY CO.	696.	1731.	438.	2864.	320.	796.	201.	1318.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	27.	27.	0.	0.	13.	13.
CONRAIL	4003.	2203.	8502.	14708.	1841.	1013.	3948.	6802.
DELAWARE & HUDSON RWY CO.	0.	157.	171.	328.	0.	72.	79.	151.
DETROIT & TOLEDO SHORELINE RR CO.	174.	0.	0.	174.	80.	0.	0.	80.
DETROIT, TOLEDO & IRONTON RR CO.	174.	0.	89.	263.	80.	0.	41.	121.
ELGIN, JOLIET & EASTERN RWY CO.	174.	315.	369.	858.	80.	145.	170.	395.
GRAND TRUNK WESTERN RR CO.	0.	157.	438.	595.	0.	72.	201.	274.
ILLINOIS TERMINAL RR CO.	0.	157.	7.	164.	0.	72.	3.	76.
LONG ISLAND RR CO.	174.	157.	69.	400.	80.	72.	32.	184.
MAINE CENTRAL RR CO.	0.	315.	96.	410.	0.	145.	44.	189.
NORFOLK & WESTERN RWY CO.	870.	1101.	1519.	3490.	400.	507.	698.	1605.
PITTSBURGH & LAKE ERIE RR CO.	0.	157.	321.	479.	0.	72.	148.	220.
RICHMOND, FREDERICKSBURG & POTOMAC R	174.	0.	68.	242.	80.	0.	32.	112.
WESTERN MARYLAND RWY CO.	174.	0.	0.	174.	80.	0.	0.	80.
CLINCHFIELD RR CO.	0.	157.	62.	219.	0.	72.	29.	101.
FLORIDA EAST COAST RWY CO.	0.	157.	62.	219.	0.	72.	29.	101.
GEORGIA RR CO.	0.	0.	34.	34.	0.	0.	16.	16.
ILLINOIS CENTRAL GULF RR CO.	522.	1101.	793.	2417.	240.	507.	365.	1112.
LOUISVILLE & NASHVILLE RR CO.	522.	315.	732.	1569.	240.	145.	337.	722.
SEABOARD COAST LINE RR CO.	348.	707.	766.	1821.	160	362.	352.	874.
SOUTHERN RY. SYSTEM	1044.	315.	844.	2203.	480	145.	388.	1013.
ATCHISON, TOPEKA & SANTA FE RWY CO.	522.	707.	650.	1879.	240	362.	299.	901.
BURLINGTON NORTHERN CO.	1218.	[illegible]	2527.	[illegible]	560	[illegible]	1163.	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	174.	1101.	677.	1952.	80	507.	311.	898.
CHICAGO, MILW., ST. PAUL & PACIFIC R	348.	2203.	[illegible]	[illegible]	160.	1013.	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO	174.	707.	732.	1613.	80.	362.	337.	779.
COLORADO & SOUTHERN RWY CO.	0.	0.	62.	62.	0.	0.	29.	29.
DENVER & RIO GRANDE WESTERN RR CO.	174.	157.	191.	522.	80.	72.	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
KANSAS CITY SOUTHERN RWY CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]	[illegible]
ST. LOUIS-SAN FRANCISCO RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
SOO LINE RR CO.	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
SOUTHERN PACIFIC CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]	0.	[illegible]
UNION PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.	[illegible]	[illegible]	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	[illegible]	[illegible]	0.	0.	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table J-12 (Option 1)

INVESTMENT TAX CREDIT SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS) REPLACEMENT ASSUMPTION APPLIED

RAILROAD NAME	NOISE SOURCE			
	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	156.	0.	50.	206.
BANGOR & AROOSTOOK RR CO.	0.	0.	2.	2.
BESSEMER & LAKE ERIE RR CO.	0.	10.	0.	10.
BOSTON & MAINE CORP.	39.	18.	24.	81.
CANADIAN PACIFIC (IN MAINE)	0.	0.	1.	1.
CENTRAL VERMONT RWY CO.	0.	0.	1.	1.
CHESAPEAKE & OHIO RWY CO.	117.	183.	40.	339.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	2.	2.
CONRAIL	740.	256.	776.	1772.
DELAWARE & HUDSON RWY CO.	0.	18.	15.	33.
DETROIT & TOLEDO SHORELINE RR CO.	39.	0.	0.	39.
DETROIT, TOLEDO & IRONTON RR CO.	39.	0.	8.	47.
ELGIN, JOLIET & EASTERN RWY CO.	39.	19.	33.	91.
GRAND TRUNK WESTERN RR CO.	0.	10.	40.	50.
ILLINOIS TERMINAL RR CO.	0.	18.	1.	19.
LONG ISLAND RR CO.	39.	18.	6.	64.
MAINE CENTRAL RR CO.	0.	18.	9.	27.
NORFOLK & WESTERN RWY CO.	176.	120.	137.	433.
PITTSBURGH & LAKE ERIE RR CO.	0.	18.	29.	48.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	39.	0.	6.	45.
WESTERN MARYLAND RWY CO.	29.	0.	0.	29.
CLINCHFIELD RR CO.	0.	18.	6.	24.
FLORIDA EAST COAST RWY CO.	0.	18.	6.	24.
GEORGIA RR CO.	0.	0.	3.	3.
ILLINOIS CENTRAL GULF RR CO.	70.	140.	72.	282.
LOUISVILLE & NASHVILLE RR CO.	70.	40.	53.	163.
SEABOARD COAST LINE RR CO.	70.	55.	99.	224.
SOUTHERN RY. SYSTEM	193.	37.	88.	317.
ATCHISON, TOPEKA & SANTA FE RWY CO.	70.	69.	90.	229.
BURLINGTON NORTHERN CO.	239.	230.	233.	702.
CHICAGO & NORTHWESTERN TRANSP. CO.	39.	120.	69.	228.
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	70.	270.	87.	427.
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	70.	97.	60.	[illegible]
COLORADO & SOUTHERN RWY CO.	0.	0.	0.	0.
DENVER & RIO GRANDE WESTERN RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	[illegible]	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	[illegible]	[illegible]	[illegible]
KANSAS CITY SOUTHERN RWY CO.	0.	[illegible]	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	[illegible]	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
NORTHWESTERN PACIFIC RR CO.	0.	0.	0.	0.
ST. LOUIS-SAN FRANCISCO RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	[illegible]	0.	[illegible]	[illegible]
SOO LINE RR CO.	0.	[illegible]	[illegible]	[illegible]
SOUTHERN PACIFIC CO.	[illegible]	[illegible]	[illegible]	[illegible]
TEXAS MEXICAN RWY CO.	0.	0.	0.	0.
TOLEDO, PEORIA & WESTERN RR CO.	0.	[illegible]	0.	[illegible]
UNION PACIFIC RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
WESTERN PACIFIC RR CO.	0.	[illegible]	[illegible]	[illegible]
ALTON & SOUTHERN RR	[illegible]	0.	[illegible]	[illegible]
BELT RY CO. OF CHICAGO	[illegible]	0.	[illegible]	[illegible]
INDIANA HARBOR BELT RR CO.	[illegible]	[illegible]	[illegible]	[illegible]
TERMINAL RR ASSN. OF ST. LOUIS	[illegible]	[illegible]	[illegible]	[illegible]
UNION RR CO.	[illegible]	0.	[illegible]	[illegible]
[illegible]	[illegible]	0.	0.	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]

Table J-12 (Option 2)

INVESTMENT TAX CREDIT SUMMARY (1979 DOLLARS)
(DOLLARS IN THOUSANDS) REPLACEMENT ASSUMPTION APPLIED

	NOISE SOURCE			
RAILROAD NAME	RETARDERS	LOAD CELL TEST SITES	SWITCHERS	TOTAL
BALTIMORE & OHIO RR CO.	195.	0.	64.	259.
BANGOR & AROOSTOCK RR CO.	0.	0.	2.	2.
BESSEMER & LAKE ERIE RR CO.	0.	10.	0.	10.
BOSTON & MAINE CORP.	39.	10.	38.	87.
CANADIAN PACIFIC (IN MAINE)	0.	0.	1.	1.
CENTRAL VERMONT RWY CO.	0.	0.	1.	1.
CHESAPEAKE & OHIO RWY CO.	156.	201.	51.	408.
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	3.	3.
CONRAIL	896.	256.	994.	2146.
DELAWARE & HUDSON RWY CO.	0.	10.	20.	30.
DETROIT & TOLEDO SHORELINE RR CO.	39.	0.	0.	39.
DETROIT, TOLEDO & IRONTON RR CO.	39.	0.	10.	49.
ELGIN, JOLIET & EASTERN RWY CO.	39.	37.	43.	119.
GRAND TRUNK WESTERN RR CO.	0.	18.	51.	69.
ILLINOIS TERMINAL RR CO.	0.	18.	1.	19.
LONG ISLAND RR CO.	39.	18.	8.	65.
MAINE CENTRAL RR CO.	0.	37.	11.	48.
NORFOLK & WESTERN RWY CO.	195.	128.	176.	499.
PITTSBURGH & LAKE ERIE RR CO.	0.	18.	37.	56.
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	39.	0.	8.	47.
WESTERN MARYLAND RWY CO.	39.	0.	0.	39.
CLINCHFIELD RR CO.	0.	18.	7.	25.
FLORIDA EAST COAST RWY CO.	0.	18.	7.	25.
GEORGIA RR CO.	0.	0.	4.	4.
ILLINOIS CENTRAL GULF RR CO.	117.	128.	92.	337.
LOUISVILLE & NASHVILLE RR CO.	117.	37.	85.	239.
SEABOARD COAST LINE RR CO.	78.	91.	89.	258.
SOUTHERN RY. SYSTEM	234.	37.	109.	380.
ATCHISON, TOPEKA & SANTA FE RWY CO.	117.	91.	75.	284.
BURLINGTON NORTHERN CO.	273.	230.	290.	800.
CHICAGO & NORTHWESTERN TRANSP. CO.	39.	128.	78.	245.
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	78.	256.	112.	446.
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	39.	91.	85.	215.
COLORADO & SOUTHERN RWY CO.	0.	0.	7.	7.
DENVER & RIO GRANDE WESTERN RR CO.	39.	18.	22.	79.
DULUTH, MISSABE & IRON RANGE RWY CO.	0.	18.	15.	33.
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.
FORT WORTH & DENVER RWY CO.	0.	18.	3.	21.
KANSAS CITY SOUTHERN RWY CO.	0.	37.	52.	89.
MISSOURI-KANSAS-TEXAS RR CO.	0.	18.	28.	46.
MISSOURI PACIFIC RR CO.	78.	73.	100.	251.
NORTHWESTERN PACIFIC RR CO.	0.	0.	0.	0.
ST. LOUIS-SAN FRANCISCO RWY CO.	39.	60.	53.	152.
ST. LOUIS SOUTHWESTERN RWY CO.	39.	0.	40.	79.
SOO LINE RR CO.	0.	37.	26.	63.
SOUTHERN PACIFIC TRANSP.	234.	278.	300.	812.
[illegible]	0.	0.	0.	0.
[illegible]	0.	18.	0.	18.
[illegible]	117.	55.	124.	296.
[illegible]	0.	18.	6.	24.
[illegible]	39.	0.	13.	52.
[illegible]	39.	0.	28.	67.
[illegible]	78.	18.	67.	163.
[illegible]	39.	18.	36.	93.
[illegible]	39.	0.	78.	117.
[illegible]	39.	0.	0.	39.
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]

Table J-13 (Option 1)

SUMMARY OF NET PRESENT VALUE OF ABATEMENT CASH FLOW
(DOLLARS IN THOUSANDS)

	NOISE SOURCE NPV OF INCREMENTAL ABATEMENT CASH FLOW				
RAILROAD NAME	RETARDERS	LCTS	SWITCHERS	TOTAL	NPV OF CASH FLOWS WITH ABATEMENT
BALTIMORE & OHIO RR CO.	1372.	0.	1338.	2711.	-48930.*
BANGOR & AROOSTOOK RR CO.	0.	0.	42.	42.	-28757.*
BESSEMER & LAKE ERIE RR CO.	0.	118.	0.	118.	84700.
BOSTON & MAINE CORP.	343.	118.	637.	1098.	-183180.*
CANADIAN PACIFIC (IN MAINE)	0.	0.	21.	21.	-2277.*
CENTRAL VERMONT RWY CO.	0.	0.	21.	21.	N/A
CHESAPEAKE & OHIO RWY CO.	1029.	1176.	1062.	3267.	-81052.*
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	64.	64.	4072.
CONRAIL	6519.	1646.	20819.	28984.	N/A
DELAWARE & HUDSON RWY CO.	0.	118.	404.	521.	-99359.*
DETROIT & TOLEDO SHORELINE RR CO.	343.	0.	0.	343.	132.
DETROIT, TOLEDO & IRONTON RR CO.	343.	0.	212.	556.	-74333.*
ELGIN, JOLIET & EASTERN RWY CO.	343.	118.	892.	1353.	108003.
GRAND TRUNK WESTERN RR CO.	0.	118.	1062.	1180.	N/A
ILLINOIS TERMINAL RR CO.	0.	118.	21.	139.	-8344.*
LONG ISLAND RR CO.	343.	118.	170.	631.	-1519625.*
MAINE CENTRAL RR CO.	.	118.	234.	351.	-15799.*
NORFOLK & WESTERN RWY CO.	13. .	823.	3675.	5071.	500457.
PITTSBURGH & LAKE ERIE RR CO.	.	118.	786.	904.	-61832.*
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	343.	0.	170.	513.	51564.
WESTERN MARYLAND RWY CO.	343.	0.	9.	343.	-12264.*
CLINCHFIELD RR CO.	0.	118.	169.	286.	N/A
FLORIDA EAST COAST RWY CO.	0.	118.	165.	264.	20566.
GEORGIA RR CO.	0.	0.	85.	85.	N/A
ILLINOIS CENTRAL GULF RR CO.	686.	823.	1933.	3443.	-479508.*
LOUISVILLE & NASHVILLE RR CO.	686.	118.	1704.	2508.	-253035.*
SEABOARD COAST LINE RR CO.	686.	670.	1669.	3026.	-273006.*
SOUTHERN RY. SYSTEM	1716.	235.	2294.	4245.	253269.
ATCHISON, TOPEKA & SANTA FE RWY CO.	686.	588.	1572.	2846.	-238968.*
BURLINGTON NORTHERN CO.	2059.	1529.	6246.	9833.	-869756.*
CHICAGO & NORTHWESTERN TRANSP. CO.	343.	823.	1636.	2802.	-36297.*
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	686.	1646.	2337.	4669.	-657008.*
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	343.	588.	1763.	2694.	-506322.*
COLORADO & SOUTHERN RWY CO.	0.	0.	149.	149.	-65008.*
DENVER & RIO GRANDE WESTERN RR CO.	343	118.	667.	1128.	73466.
DULUTH, MISSABE & IRON RANGE RWY CO.		118.	297.	415.	7864.
DULUTH, WINNIPEG & PACIFIC RWY	0.	0.	0.	0.	61207.
FORT WORTH & DENVER RWY CO.	0.	118.	49.	167.	-50577.*
KANSAS CITY SOUTHERN RWY CO.	0.	118.	1083.	1201.	-32029.*
MISSOURI-KANSAS-TEXAS RR CO.	0.	118.	579.	697.	N/A
MISSOURI PACIFIC RR CO.	686.	1176.	3888.	5750.	653252.
NORTHWESTERN PACIFIC RR CO.	0.	[illegible]	108.	108.	N/A
ST. LOUIS-SAN FRANCISCO RWY CO.	343.	118.	1085.	1547.	[illegible]
ST. LOUIS SOUTHWESTERN RWY CO.	343.	0.	829.	1172.	266517.
SOO LINE RR CO.	0.	118.	558.	676.	589622.
SOUTHERN PACIFIC CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.	[illegible]
[illegible]	0.	118.	0.	118.	[illegible]
[illegible]	686.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	118.	[illegible]	[illegible]	[illegible]
[illegible]	343.	0.	[illegible]	[illegible]	[illegible]
[illegible]	343.	0.	[illegible]	[illegible]	[illegible]
[illegible]	686.	118.	[illegible]	[illegible]	[illegible]
[illegible]	343.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	343.	0.	[illegible]	[illegible]	[illegible]
[illegible]	343.	0.	0.	343.	N/A
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* - NPV LESS THAN OR EQUAL TO ZERO

Table J-13 (Option 2)

SUMMARY OF NET PRESENT VALUE OF ABATEMENT CASH FLOW
(DOLLARS IN THOUSANDS)

RAILROAD NAME	NOISE SOURCE NPV OF INCREMENTAL ABATEMENT CASH FLOW RETARDERS	LCTS	SWITCHERS	TOTAL	NPV OF CASH FLOWS WITH ABATEMENT
BALTIMORE & OHIO RR CO.	1718.	0.	1721.	3439.	-89656.*
BANGOR & AROOSTOOK RR CO.	0.	0.	62.	62.	-28753.*
BESSEMER & LAKE ERIE RR CO.	0.	110.	0.	110.	84700.
BOSTON & MAINE CORP.	363.	110.	807.	1280.	-163350.*
CANADIAN PACIFIC (IN MAINE)	0.	0.	21.	21.	-2277.*
CENTRAL VERMONT RWY CO.	0.	0.	21.	21.	N/A
CHESAPEAKE & OHIO RWY CO.	1372.	1293.	1360.	4025.	-61010.*
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.	0.	85.	85.	6051.
CONRAIL	9091.	1046.	26062.	36199.	N/A
DELAWARE & HUDSON RWY CO.	0.	110.	531.	641.	-99467.*
DETROIT & TOLEDO SHORELINE RR CO.	363.	0.	0.	363.	122.
DETROIT, TOLEDO & IRONTON RR CO.	363.	0.	276.	639.	-36202.*
ELGIN, JOLIET & EASTERN RWY CO.	363.	235.	1127.	1725.	107621.
GRAND TRUNK WESTERN RR CO.	0.	110.	1367.	1477.	N/A
ILLINOIS TERMINAL RR CO.	0.	110.	21.	131.	-6369.*
LONG ISLAND RR CO.	363.	110.	212.	685.	-1519660.*
MAINE CENTRAL RR CO.	0.	235.	297.	532.	-55681.*
NORFOLK & WESTERN RWY CO.	1718.	823.	6714.	9255.	538873.
PITTSBURGH & LAKE ERIE RR CO.	0.	110.	998.	1108.	-62086.*
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	363.	0.	212.	575.	59522.
WESTERN MARYLAND RWY CO.	363.	0.	0.	363.	-72266.*
CLINCHFIELD RR CO.	0.	110.	399.	509.	N/A
FLORIDA EAST COAST RWY CO.	0.	110.	391.	501.	28512.
GEORGIA RR CO.	0.	0.	586.	586.	N/A
ILLINOIS CENTRAL GULF RR CO.	1029.	823.	2466.	4318.	-680870.*
LOUISVILLE & NASHVILLE RR CO.	1019.	235.	2275.	3529.	-253366.*
SEABOARD COAST LINE RR CO.	686.	[illegible]	[illegible]	[illegible]	[illegible]
SOUTHERN RY. SYSTEM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ATCHISON, TOPEKA & SANTA FE RWY CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BURLINGTON NORTHERN CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO & NORTHWESTERN TRANSP. CO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	363.	[illegible]	[illegible]	[illegible]	[illegible]
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	686.	[illegible]	[illegible]	[illegible]	[illegible]
COLORADO & SOUTHERN RWY CO.	363.	[illegible]	[illegible]	[illegible]	[illegible]
DENVER & RIO GRANDE WESTERN RR CO.	0.	0.	[illegible]	[illegible]	[illegible]
DULUTH, MISSABE & IRON RANGE RWY CO.	363.	110.	[illegible]	[illegible]	[illegible]
DULUTH, WINNIPEG & PACIFIC RWY	0.	110.	[illegible]	[illegible]	[illegible]
FORT WORTH & DENVER RWY CO.	0.	0.	0.	0.	[illegible]
KANSAS CITY SOUTHERN RWY CO.	0.	110.	[illegible]	[illegible]	[illegible]
MISSOURI-KANSAS-TEXAS RR CO.	0.	[illegible]	[illegible]	[illegible]	[illegible]
MISSOURI PACIFIC RR CO.	0.	110.	[illegible]	[illegible]	N/A
[illegible]	686.	[illegible]	[illegible]	[illegible]	[illegible]
ST. LOUIS-SAN FRANCISCO RWY CO.	0.	0.	[illegible]	[illegible]	N/A
ST. LOUIS SOUTHWESTERN RWY CO.	363.	110.	[illegible]	[illegible]	[illegible]
SOO LINE RR CO.	363.	0.	[illegible]	[illegible]	[illegible]
SOUTHERN PACIFIC CO.	0.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	0.	0.	0.	[illegible]
[illegible]	0.	110.	0.	110.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0.	110.	[illegible]	[illegible]	[illegible]
[illegible]	363.	0.	[illegible]	[illegible]	[illegible]
[illegible]	363.	0.	[illegible]	[illegible]	[illegible]
[illegible]	686.	110.	[illegible]	[illegible]	[illegible]
[illegible]	363.	110.	[illegible]	[illegible]	[illegible]
[illegible]	363.	0.	[illegible]	[illegible]	[illegible]
[illegible]	363.	0.	0.	[illegible]	N/A
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* - [illegible]

Table J-14 (Option 1)

RAILROAD COMPANIES WITH POSITIVE NET PRESENT VALUE

RAILROAD NAME	NET PRESENT VALUE
BESSEMER & LAKE ERIE RR CO.	84700.00
CHICAGO & ILLINOIS MIDLAND RWY CO.	4072.13
DETROIT & TOLEDO SHORELINE RR CO.	131.74
ELGIN, JOLIET & EASTERN RWY CO.	108003.06
NORFOLK & WESTERN RWY CO.	540457.25
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	51564.32
FLORIDA EAST COAST RWY CO.	20565.77
SOUTHERN RY. SYSTEM	253266.62
DENVER & RIO GRANDE WESTERN RR CO.	77645.75
DULUTH, MISSABE & IRON RANGE RWY CO.	7065.81
DULUTH, WINNIPEG & PACIFIC RWY	61207.11
MISSOURI PACIFIC RR CO.	853211.56
ST. LOUIS SOUTHWESTERN RWY CO.	246131.84
SOO LINE RR CO.	101422.94
TEXAS MEXICAN RWY CO.	9395.00
ALTON & SOUTHERN RR	12401.82
UNION RR CO.	8135.89

Table J-14 (Option 2)

RAILROAD COMPANIES WITH POSITIVE NET PRESENT VALUE

RAILROAD NAME	NET PRESENT VALUE
BESSEMER & LAKE ERIE RR CO.	84700.00
CHICAGO & ILLINOIS MIDLAND RWY CO.	4050.89
DETROIT & TOLEDO SHORELINE RR CO.	131.74
ELGIN, JOLIET & EASTERN RWY CO.	107630.50
NORFOLK & WESTERN RWY CO.	539073.19
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	51521.83
FLORIDA EAST COAST RWY CO.	20523.28
SOUTHERN RY. SYSTEM	252288.19
DENVER & RIO GRANDE WESTERN RR CO.	77518.25
DULUTH, MISSABE & IRON RANGE RWY CO.	6980.84
DULUTH, WINNIPEG & PACIFIC RWY	61207.11
MISSOURI PACIFIC RR CO.	452106.87
ST. LOUIS SOUTHWESTERN RWY CO.	245897.75
SOO LINE RR CO.	101156.62
TEXAS MEXICAN RWY CO.	9395.00
ALTON & SOUTHERN RR	12338.09
UNION RR CO.	7711.01

Table J-15 (Option 1)

RAILROAD COMPANIES WITH NEGATIVE OR ZERO NET PRESENT VALUE

RAILROAD NAME	NET PRESENT VALUE
BALTIMORE & OHIO RR CO.	-48930.03
BANGOR & AROOSTOCK RR CO.	-28757.34
BOSTON & MAINE CORP.	-143180.37
CANADIAN PACIFIC (IN MAINE)	-2277.24
CHESAPEAKE & OHIO RWY CO.	-41051.67
DELAWARE & HUDSON RWY CO.	-99359.44
DETROIT, TOLEDO & IRONTON RR CO.	-74333.25
ILLINOIS TERMINAL RR CO.	-8344.13
LONG ISLAND RR CO.	-1519625.00
MAINE CENTRAL RR CO.	-15799.37
PITTSBURGH & LAKE ERIE RR CO.	-61831.80
WESTERN MARYLAND RWY CO.	-12246.35
ILLINOIS CENTRAL GULF RR CO.	-479943.56
LOUISVILLE & NASHVILLE RR CO.	-253034.62
SEABOARD COAST LINE RR CO.	-273846.44
ATCHISON, TOPEKA & SANTA FE RWY CO.	-234948.12
BURLINGTON NORTHERN CO.	-849755.50
CHICAGO & NORTHWESTERN TRANSP. CO.	-76296.50
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-657404.31
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-504332.25
COLORADO & SOUTHERN RWY CO.	-45008.47
FORT WORTH & DENVER RWY CO.	-18915.26
KANSAS CITY SOUTHERN RWY CO.	-32829.21
ST. LOUIS-SAN FRANCISCO RWY CO.	-11950.25
SOUTHERN PACIFIC CO.	-448023.44
TOLEDO, PEORIA & WESTERN RR CO.	-5879.60
UNION PACIFIC RR CO.	-738802.37
WESTERN PACIFIC RR CO.	-322933.75
BELT RR CO. OF CHICAGO	-6296.70
INDIANA HARBOR BELT RR CO.	-22146.77
TERMINAL RR ASSN. OF ST. LOUIS	-39483.46

Table J-15 (Option 2)

RAILROAD COMPANIES WITH NEGATIVE OR ZERO NET PRESENT VALUE

RAILROAD NAME	NET PRESENT VALUE
BALTIMORE & OHIO RR CO.	-49655.52
BANGOR & AROOSTOOK RR CO.	-28757.34
BOSTON & MAINE CORP.	-143350.31
CANADIAN PACIFIC (IN MAINE)	-2277.24
CHESAPEAKE & OHIO RWY CO.	-41809.77
DELAWARE & HUDSON RWY CO.	-99486.87
DETROIT, TOLEDO & IRONTON RR CO.	-74397.00
ILLINOIS TERMINAL RR CO.	-8344.13
LONG ISLAND RR CO.	-1519668.00
MAINE CENTRAL RR CO.	-15980.69
PITTSBURGH & LAKE ERIE RR CO.	-62044.24
WESTERN MARYLAND RWY CO.	-12246.35
ILLINOIS CENTRAL GULF RR CO.	-480817.75
LOUISVILLE & NASHVILLE RR CO.	-253983.94
SEABOARD COAST LINE RR CO.	-274473.87
ATCHISON, TOPEKA & SANTA FE RWY CO.	-235737.37
BURLINGTON NORTHERN CO.	-851840.56
CHICAGO & NORTHWESTERN TRANSP. CO.	-76763.87
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-658062.87
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-504842.12
COLORADO & SOUTHERN RWY CO.	-45050.96
FORT WORTH & DENVER RWY CO.	-18936.50
KANSAS CITY SOUTHERN RWY CO.	-33265.46
ST. LOUIS-SAN FRANCISCO RWY CO.	-12268.91
SOUTHERN PACIFIC CO.	-450151.06
TOLEDO, PEORIA & WESTERN RR CO.	-5879.60
UNION PACIFIC RR CO.	-739931.50
WESTERN PACIFIC RR CO.	-322955.00
BELT RR CO. OF CHICAGO	-6466.65
INDIANA HARBOR BELT RR CO.	-22507.91
TERMINAL RR ASSN. OF ST. LOUIS	-39695.91

Table J-16 (Option 1)

RAILROAD COMPANIES WITH .1 >= RATIO > 0

RAILROAD NAME	RATIO
DETROIT & TOLEDO SHORELINE RR CO.	0.01
DULUTH, MISSABE & IRON RANGE RWY CO.	0.08

Table J-16 (Option 2)

RAILROAD COMPANIES WITH .1 >= RATIO > 0

RAILROAD NAME	RATIO
DETROIT & TOLEDO SHORELINE RR CO.	0.01
DULUTH, MISSABE & IRON RANGE RWY CO.	0.08

Table J-17 (Option 1)

RAILROAD COMPANIES WITH RATIO > .1

RAILROAD NAME	RATIO
BESSEMER & LAKE ERIE RR CO.	0.91
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.22
ELGIN, JOLIET & EASTERN RWY CO.	1.46
NORFOLK & WESTERN RWY CO.	0.49
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	0.67
FLORIDA EAST COAST RWY CO.	0.22
SOUTHERN RY. SYSTEM	0.25
DENVER & RIO GRANDE WESTERN RR CO.	0.39
DULUTH, WINNIPEG & PACIFIC RWY	3.87
MISSOURI PACIFIC RR CO.	0.86
ST. LOUIS SOUTHWESTERN RWY CO.	0.83
SOO LINE RR CO.	0.63
TEXAS MEXICAN RWY CO.	2.30
ALTON & SOUTHERN RR	0.61
UNION RR CO.	0.17

Table J-17 (Option 2)

RAILROAD COMPANIES WITH RATIO > .1

RAILROAD NAME	RATIO
BESSEMER & LAKE ERIE RR CO.	0.91
CHICAGO & ILLINOIS MIDLAND RWY CO.	0.22
ELGIN, JOLIET & EASTERN RWY CO.	1.45
NORFOLK & WESTERN RWY CO.	0.49
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	0.67
FLORIDA EAST COAST RWY CO.	0.22
SOUTHERN RY. SYSTEM	0.25
DENVER & RIO GRANDE WESTERN RR CO.	0.39
DULUTH, WINNIPEG & PACIFIC RWY	3.87
MISSOURI PACIFIC RR CO.	0.86
ST. LOUIS SOUTHWESTERN RWY CO.	0.83
SOO LINE RR CO.	0.62
TEXAS MEXICAN RWY CO.	2.30
ALTON & SOUTHERN RR	0.61
UNION RR CO.	0.16

Table J-18 (Option 1)

RAILROAD COMPANIES WITH RATIO <= 0

RAILROAD NAME	RATIO
BALTIMORE & OHIO RR CO.	-0.07
BANGOR & AROOSTOCK RR CO.	-0.77
BOSTON & MAINE CORP.	-2.54
CANADIAN PACIFIC (IN MAINE)	-1.01
CHESAPEAKE & OHIO RWY CO.	-0.06
DELAWARE & HUDSON RWY CO.	-2.66
DETROIT, TOLEDO & IRONTON RR CO.	-1.46
ILLINOIS TERMINAL RR CO.	-0.71
LONG ISLAND RR CO.	-13.23
MAINE CENTRAL RR CO.	-0.39
PITTSBURGH & LAKE ERIE RR CO.	-0.36
WESTERN MARYLAND RWY CO.	-0.14
ILLINOIS CENTRAL GULF RR CO.	-0.70
LOUISVILLE & NASHVILLE RR CO.	-0.49
SEABOARD COAST LINE RR CO.	-0.25
ATCHISON, TOPEKA & SANTA FE RWY CO.	-0.17
BURLINGTON NORTHERN CO.	-0.49
CHICAGO & NORTHWESTERN TRANSP. CO.	-3.58
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-2.21
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-3.22
COLORADO & SOUTHERN RWY CO.	-0.62
FORT WORTH & DENVER RWY CO.	-0.56
KANSAS CITY SOUTHERN RWY CO.	-0.26
ST. LOUIS-SAN FRANCISCO RWY CO.	-0.06
SOUTHERN PACIFIC CO.	-0.30
TOLEDO, PEORIA & WESTERN RR CO.	-0.59
UNION PACIFIC RR CO.	-0.29
WESTERN PACIFIC RR CO.	-2.98
BELT RR CO. OF CHICAGO	-1.05
INDIANA HARBOR BELT RR CO.	-1.48
TERMINAL RR ASSN. OF ST. LOUIS	-38.32

Table J-18 (Option 2)

RAILROAD COMPANIES WITH RATIO <= 0

RAILROAD NAME	RATIO
BALTIMORE & OHIO RR CO.	-0.07
BANGOR & AROOSTOOK RR CO.	-0.77
BOSTON & MAINE CORP.	-2.54
CANADIAN PACIFIC (IN MAINE)	-1.01
CHESAPEAKE & OHIO RWY CO.	-0.06
DELAWARE & HUDSON RWY CO.	-2.67
DETROIT, TOLEDO & IRONTON RR CO.	-1.46
ILLINOIS TERMINAL RR CO.	-0.71
LONG ISLAND RR CO.	-13.23
MAINE CENTRAL RR CO.	-0.40
PITTSBURGH & LAKE ERIE RR CO.	-0.36
WESTERN MARYLAND RWY CO.	-0.14
ILLINOIS CENTRAL GULF RR CO.	-0.70
LOUISVILLE & NASHVILLE RR CO.	-0.48
SEABOARD COAST LINE RR CO.	-0.25
ATCHISON, TOPEKA & SANTA FE RWY CO.	-0.17
BURLINGTON NORTHERN CO.	-0.49
CHICAGO & NORTHWESTERN TRANSP. CO.	-3.60
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-2.21
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-3.22
COLORADO & SOUTHERN RWY CO.	-0.62
FORT WORTH & DENVER RWY CO.	-0.56
KANSAS CITY SOUTHERN RWY CO.	-0.27
ST. LOUIS-SAN FRANCISCO RWY CO.	-0.06
SOUTHERN PACIFIC CO.	-0.30
TOLEDO, PEORIA & WESTERN RR CO.	-0.59
UNION PACIFIC RR CO.	-0.29
WESTERN PACIFIC RR CO.	-2.98
BELT RR CO. OF CHICAGO	-1.08
INDIANA HARBOR BELT RR CO.	-1.51
TERMINAL RR ASSN. OF ST. LOUIS	-38.53

Table J-19 (Option 1)

RAILROAD COMPANIES WITH POSITIVE FUTURE CASH FLOW

RAILROAD NAME	FUTURE CASH FLOW
BALTIMORE & OHIO RR CO.	643733.37
BANGOR & AROOSTOOK RR CO.	8807.81
BESSEMER & LAKE ERIE RR CO.	177621.62
CENTRAL VERMONT RWY CO.	9226.13
CHESAPEAKE & OHIO RWY CO.	612287.81
CHICAGO & ILLINOIS MIDLAND RWY CO.	22489.86
DETROIT & TOLEDO SHORELINE RR CO.	11775.34
ELGIN, JOLIET & EASTERN RWY CO.	183572.81
ILLINOIS TERMINAL RR CO.	3610.03
MAINE CENTRAL RR CO.	24988.23
NORFOLK & WESTERN RWY CO.	1646700.00
PITTSBURGH & LAKE ERIE RR CO.	111524.81
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	129464.00
WESTERN MARYLAND RWY CO.	74934.56
FLORIDA EAST COAST RWY CO.	114210.37
ILLINOIS CENTRAL GULF RR CO.	211893.75
LOUISVILLE & NASHVILLE RR CO.	280082.12
SEABOARD COAST LINE RR CO.	832552.56
SOUTHERN RY. SYSTEM	1253665.00
ATCHISON, TOPEKA & SANTA FE RWY CO.	1132298.00
BURLINGTON NORTHERN CO.	911217.44
COLORADO & SOUTHERN RWY CO.	27766.23
DENVER & RIO GRANDE WESTERN RR CO.	277075.31
DULUTH, MISSABE & IRON RANGE RWY CO.	97928.31
DULUTH, WINNIPEG & PACIFIC RWY	77035.44
FORT WORTH & DENVER RWY CO.	14913.89
KANSAS CITY SOUTHERN RWY CO.	92510.94
MISSOURI PACIFIC RR CO.	982705.81
ST. LOUIS-SAN FRANCISCO RWY CO.	203640.62
ST. LOUIS SOUTHWESTERN RWY CO.	544778.87
SOO LINE RR CO.	264058.87
SOUTHERN PACIFIC CO.	1069674.00
TEXAS MEXICAN RWY CO.	13478.66
TOLEDO, PEORIA & WESTERN RR CO.	4153.15
UNION PACIFIC RR CO.	1779736.00
ALTON & SOUTHERN RR	33259.86
BELT RR CO. OF CHICAGO	591.66
UNION RR CO.	57822.81

Table J-19 (Option 2)

RAILROAD COMPANIES WITH POSITIVE FUTURE CASH FLOW

RAILROAD NAME	FUTURE CASH FLOW
BALTIMORE & OHIO RR CO.	643733.37
BANGOR & AROOSTOCK RR CO.	8807.81
BESSEMER & LAKE ERIE RR CO.	177621.62
CENTRAL VERMONT RWY CO.	9226.13
CHESAPEAKE & OHIO RWY CO.	612287.91
CHICAGO & ILLINOIS MIDLAND RWY CO.	22489.36
DETROIT & TOLEDO SHORELINE RR CO.	11775.34
ELGIN, JOLIET & EASTERN RWY CO.	183572.81
ILLINOIS TERMINAL RR CO.	3610.03
MAINE CENTRAL RR CO.	24988.23
NORFOLK & WESTERN RWY CO.	1646700.00
PITTSBURGH & LAKE ERIE RR CO.	111524.81
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	129464.00
WESTERN MARYLAND RWY CO.	74934.56
FLORIDA EAST COAST RWY CO.	114210.37
ILLINOIS CENTRAL GULF RR CO.	211893.75
LOUISVILLE & NASHVILLE RR CO.	280082.12
SEABOARD COAST LINE RR CO.	832552.56
SOUTHERN RY. SYSTEM	1253665.00
ATCHISON, TOPEKA & SANTA FE RWY CO.	1132298.00
BURLINGTON NORTHERN CO.	911217.44
COLORADO & SOUTHERN RWY CO.	27766.23
DENVER & RIO GRANDE WESTERN RR CO.	277075.31
DULUTH, MISSABE & IRON RANGE RWY CO.	97928.31
DULUTH, WINNIPEG & PACIFIC RWY	77035.44
FORT WORTH & DENVER RWY CO.	14913.89
KANSAS CITY SOUTHERN RWY CO.	92510.94
MISSOURI PACIFIC RR CO.	982705.81
ST. LOUIS-SAN FRANCISCO RWY CO.	203640.62
ST. LOUIS SOUTHWESTERN RWY CO.	544778.87
SOO LINE RR CO.	264058.87
SOUTHERN PACIFIC CO.	1069674.00
TEXAS MEXICAN RWY CO.	13478.66
TOLEDO, PEORIA & WESTERN RR CO.	4153.15
UNION PACIFIC RR CO.	1779736.00
ALTON & SOUTHERN RR	33259.86
BELT RR CO. OF CHICAGO	591.66
UNION RR CO.	57822.81

Table J-20 (Option 1)

RAILROAD COMPANIES WITH NEGATIVE FUTURE CASH FLOW

RAILROAD NAME	FUTURE CASH FLOW
BOSTON & MAINE CORP.	-85635.25
CANADIAN PACIFIC (IN MAINE)	0.0
CONRAIL	-8082216.00
DELAWARE & HUDSON RWY CO.	-61525.29
DETROIT, TOLEDO & IRONTON RR CO.	-22915.12
GRAND TRUNK WESTERN RR CO.	-43613.84
LONG ISLAND RR CO.	-1404094.00
CLINCHFIELD RR CO.	0.0
GEORGIA RR CO.	0.0
CHICAGO & NORTHWESTERN TRANSP. CO.	-52165.12
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-355566.81
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-344808.37
MISSOURI-KANSAS-TEXAS RR CO.	-63406.58
NORTHWESTERN PACIFIC RR CO.	-22762.58
WESTERN PACIFIC RR CO.	-214292.75
INDIANA HARBOR BELT RR CO.	-5140.01
TERMINAL RR ASSN. OF ST. LOUIS	-37248.91
YOUNGSTOWN & SOUTHERN RWY CO.	-1095187.00

Table J-20 (Option 2)

RAILROAD COMPANIES WITH NEGATIVE FUTURE CASH FLOW

RAILROAD NAME	FUTURE CASH FLOW
BOSTON & MAINE CORP.	-85635.25
CANADIAN PACIFIC (IN MAINE)	0.0
CONRAIL	-8082216.00
DELAWARE & HUDSON RWY CO.	-61525.29
DETROIT, TOLEDO & IRONTON RR CO.	-22915.12
GRAND TRUNK WESTERN RR CO.	-43613.84
LONG ISLAND RR CO.	-1404094.00
CLINCHFIELD RR CO.	0.0
GEORGIA RR CO.	0.0
CHICAGO & NORTHWESTERN TRANSP. CO.	-52165.12
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-355566.81
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-344808.37
MISSOURI-KANSAS-TEXAS RR CO.	-63406.58
NORTHWESTERN PACIFIC RR CO.	-22762.58
WESTERN PACIFIC RR CO.	-214292.75
INDIANA HARBOR BELT RR CO.	-5140.01
TERMINAL RR ASSN. OF ST. LOUIS	-37248.91
YOUNGSTOWN & SOUTHERN RWY CO.	-1095187.00

Table J-21 (Option 1)

RAILROAD COMPANIES WITH POSITIVE NET INVESTMENT

RAILROAD NAME	NET INVESTMENT
BALTIMORE & OHIO RR CO.	689952.62
BANGOR & AROOSTOCK RR CO.	37522.66
BESSEMER & LAKE ERIE RR CO.	92804.00
BOSTON & MAINE CORP.	56447.16
CANADIAN PACIFIC (IN MAINE)	2256.00
CHESAPEAKE & OHIO RWY CO.	650072.12
CHICAGO & ILLINOIS MIDLAND RWY CO.	18354.00
DELAWARE & HUDSON RWY CO.	37313.00
DETROIT & TOLEDO SHORELINE RR CO.	11300.50
DETROIT, TOLEDO & IRONTON RR CO.	50862.66
ELGIN, JOLIET & EASTERN RWY CO.	74216.81
ILLINOIS TERMINAL RR CO.	11815.33
LONG ISLAND RR CO.	114901.31
MAINE CENTRAL RR CO.	40436.33
NORFOLK & WESTERN RWY CO.	1100372.00
PITTSBURGH & LAKE ERIE RR CO.	172453.00
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	77386.62
WESTERN MARYLAND RWY CO.	86837.81
FLORIDA EAST COAST RWY CO.	93378.31
ILLINOIS CENTRAL GULF RR CO.	688394.81
LOUISVILLE & NASHVILLE RR CO.	530528.50
SEABOARD COAST LINE RR CO.	1103373.00
SOUTHERN RY. SYSTEM	996151.31
ATCHISON, TOPEKA & SANTA FE RWY CO.	1364400.00
BURLINGTON NORTHERN CO.	1751140.00
CHICAGO & NORTHWESTERN TRANSP. CO.	21329.50
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	297168.31
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	156829.62
COLORADO & SOUTHERN RWY CO.	72626.00
DENVER & RIO GRANDE WESTERN RR CO.	198501.50
DULUTH, MISSABE & IRON RANGE RWY CO.	90447.50
DULUTH, WINNIPEG & PACIFIC RWY	15828.33
FORT WORTH & DENVER RWY CO.	33647.83
KANSAS CITY SOUTHERN RWY CO.	124139.12
MISSOURI PACIFIC RR CO.	524343.81
ST. LOUIS-SAN FRANCISCO RWY CO.	214025.50
ST. LOUIS SOUTHWESTERN RWY CO.	297475.81
SOO LINE RR CO.	161966.00
SOUTHERN PACIFIC CO.	1507845.00
TEXAS MEXICAN RWY CO.	4083.67
TOLEDO, PEORIA & WESTERN RR CO.	9915.16
UNION PACIFIC RR CO.	2514674.00
WESTERN PACIFIC RR CO.	108396.00
ALTON & SOUTHERN RR	20260.00
BELT RR CO. OF CHICAGO	5971.66
INDIANA HARBOR BELT RR CO.	14928.33
TERMINAL RR ASSN. OF ST. LOUIS	1030.33
UNION RR CO.	47835.50

Table J-21 (Option 2)

RAILROAD COMPANIES WITH POSITIVE NET INVESTMENT

RAILROAD NAME	NET INVESTMENT
BALTIMORE & OHIO RR CO.	689952.62
BANGOR & AROOSTOCK RR CO.	37522.66
BESSEMER & LAKE ERIE RR CO.	92804.00
BOSTON & MAINE CORP.	56447.16
CANADIAN PACIFIC (IN MAINE)	2256.00
CHESAPEAKE & OHIO RWY CO.	650072.12
CHICAGO & ILLINOIS MIDLAND RWY CO.	18354.00
DELAWARE & HUDSON RWY CO.	37313.00
DETROIT & TOLEDO SHORELINE RR CO.	11300.50
DETROIT, TOLEDO & IRONTON RR CO.	50862.66
ELGIN, JOLIET & EASTERN RWY CO.	74216.81
ILLINOIS TERMINAL RR CO.	11815.33
LONG ISLAND RR CO.	114901.31
MAINE CENTRAL RR CO.	40436.33
NORFOLK & WESTERN RWY CO.	1100372.00
PITTSBURGH & LAKE ERIE RR CO.	172453.00
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	77386.62
WESTERN MARYLAND RWY CO.	86837.81
FLORIDA EAST COAST RWY CO.	93378.31
ILLINOIS CENTRAL GULF RR CO.	688394.81
LOUISVILLE & NASHVILLE RR CO.	530528.50
SEABOARD COAST LINE RR CO.	1103373.00
SOUTHERN RY. SYSTEM	996151.31
ATCHISON, TOPEKA & SANTA FE RWY CO.	1364400.00
BURLINGTON NORTHERN CO.	1751140.00
CHICAGO & NORTHWESTERN TRANSP. CO.	21329.50
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	297168.31
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	156829.62
COLORADO & SOUTHERN RWY CO.	72626.00
DENVER & RIO GRANDE WESTERN RR CO.	198501.50
DULUTH, MISSABE & IRON RANGE RWY CO.	90447.50
DULUTH, WINNIPEG & PACIFIC RWY	15828.33
FORT WORTH & DENVER RWY CO.	33647.83
KANSAS CITY SOUTHERN RWY CO.	124139.12
MISSOURI PACIFIC RR CO.	524343.81
ST. LOUIS-SAN FRANCISCO RWY CO.	214025.50
ST. LOUIS SOUTHWESTERN RWY CO.	297475.81
SOO LINE RR CO.	161966.00
SOUTHERN PACIFIC CO.	1507845.00
TEXAS MEXICAN RWY CO.	4083.67
TOLEDO, PEORIA & WESTERN RR CO.	9915.16
UNION PACIFIC RR CO.	2514674.00
WESTERN PACIFIC RR CO.	108396.00
ALTON & SOUTHERN RR	20260.00
BELT RR CO. OF CHICAGO	5971.66
INDIANA HARBOR BELT RR CO.	14928.33
TERMINAL RR ASSN. OF ST. LOUIS	1030.33
UNION RR CO.	47835.50

Table J-22 (Option 1)

RAILROAD COMPANIES WITH NEGATIVE NET INVESTMENT

RAILROAD NAME	NET INVESTMENT
CENTRAL VERMONT RWY CO.	-9142.50
CONRAIL	-73919.31
GRAND TRUNK WESTERN RR CO.	-115541.12
CLINCHFIELD RR CO.	0.0
GEORGIA RR CO.	0.0
MISSOURI-KANSAS-TEXAS RR CO.	-24144.83
NORTHWESTERN PACIFIC RR CO.	-20098.00
YOUNGSTOWN & SOUTHERN RWY CO.	-14804.16

Table J-22 (Option 2)

RAILROAD COMPANIES WITH NEGATIVE NET INVESTMENT

RAILROAD NAME	NET INVESTMENT
CENTRAL VERMONT RWY CO.	-9142.50
CONRAIL	-73919.31
GRAND TRUNK WESTERN RR CO.	-115541.12
CLINCHFIELD RR CO.	0.0
GEORGIA RR CO.	0.0
MISSOURI-KANSAS-TEXAS RR CO.	-24144.83
NORTHWESTERN PACIFIC RR CO.	-20098.00
YOUNGSTOWN & SOUTHERN RWY CO.	-14804.16

Table J-23 (Option 1)

RAILROAD COMPANIES WITH POSITIVE NET PRESENT VALUE OF FUTURE CASH FLOWS BEFORE ABATEMENT

RAILROAD NAME	NET PRESENT VALUE
BESSEMER & LAKE ERIE RR CO.	84817.62
CENTRAL VERMONT RWY CO.	18368.63
CHICAGO & ILLINOIS MIDLAND RWY CO.	4135.86
DETROIT & TOLEDO SHORELINE RR CO.	474.84
ELGIN, JOLIET & EASTERN RWY CO.	109356.00
GRAND TRUNK WESTERN RR CO.	71927.25
NORFOLK & WESTERN RWY CO.	546328.00
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	52077.37
FLORIDA EAST COAST RWY CO.	20832.06
SOUTHERN RY. SYSTEM	257513.69
DENVER & RIO GRANDE WESTERN RR CO.	78573.81
DULUTH, MISSABE & IRON RANGE RWY CO.	7480.81
DULUTH, WINNIPEG & PACIFIC RWY	61207.11
MISSOURI PACIFIC RR CO.	458362.00
ST. LOUIS SOUTHWESTERN RWY CO.	247303.06
SOO LINE RR CO.	102092.87
TEXAS MEXICAN RWY CO.	9395.00
ALTON & SOUTHERN RR	12999.86
UNION RR CO.	9987.31

Table J-23 (Option 2)

RAILROAD COMPANIES WITH POSITIVE NET PRESENT VALUE OF FUTURE CASH FLOWS BEFORE ABATEMENT

RAILROAD NAME	NET PRESENT VALUE
BESSEMER & LAKE ERIE RR CO.	84817.62
CENTRAL VERMONT RWY CO.	18368.63
CHICAGO & ILLINOIS MIDLAND RWY CO.	4135.86
DETROIT & TOLEDO SHORELINE RR CO.	474.84
ELGIN, JOLIET & EASTERN RWY CO.	109356.00
GRAND TRUNK WESTERN RR CO.	71927.25
NORFOLK & WESTERN RWY CO.	546328.00
RICHMOND, FREDERICKSBURG & POTOMAC RR CO.	52077.37
FLORIDA EAST COAST RWY CO.	20832.06
SOUTHERN RY. SYSTEM	257513.69
DENVER & RIO GRANDE WESTERN RR CO.	78573.81
DULUTH, MISSABE & IRON RANGE RWY CO.	7480.81
DULUTH, WINNIPEG & PACIFIC RWY	61207.11
MISSOURI PACIFIC RR CO.	458362.00
ST. LOUIS SOUTHWESTERN RWY CO.	247303.06
SOO LINE RR CO.	102092.87
TEXAS MEXICAN RWY CO.	9395.00
ALTON & SOUTHERN RR	12999.86
UNION RR CO.	9987.31

Table J-24 (Option 1)

RAILROAD COMPANIES WITH NEGATIVE NET PRESENT VALUE OF FUTURE CASH FLOWS BEFORE ABATEMENT

RAILROAD NAME	NET PRESENT VALUE
BALTIMORE & OHIO RR CO.	-46219.25
BANGOR & AROOSTOOK RR CO.	-28714.85
BOSTON & MAINE CORP.	-142082.37
CANADIAN PACIFIC (IN MAINE)	-2256.00
CHESAPEAKE & OHIO RWY CO.	-37784.31
DELAWARE & HUDSON RWY CO.	-98838.25
DETROIT, TOLEDO & IRONTON RR CO.	-73777.75
ILLINOIS TERMINAL RR CO.	-8205.30
LONG ISLAND RR CO.	-1518995.00
MAINE CENTRAL RR CO.	-15448.11
PITTSBURGH & LAKE ERIE RR CO.	-60928.19
WESTERN MARYLAND RWY CO.	-11903.25
ILLINOIS CENTRAL GULF RR CO.	-476501.06
LOUISVILLE & NASHVILLE RR CO.	-250446.37
SEABOARD COAST LINE RR CO.	-270820.44
ATCHISON, TOPEKA & SANTA FE RWY CO.	-232102.00
BURLINGTON NORTHERN CO.	-839922.56
CHICAGO & NORTHWESTERN TRANSP. CO.	-73494.56
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-652735.12
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-501638.00
COLORADO & SOUTHERN RWY CO.	-44859.77
FORT WORTH & DENVER RWY CO.	-18733.94
KANSAS CITY SOUTHERN RWY CO.	-31628.19
ST. LOUIS-SAN FRANCISCO RWY CO.	-10384.87
SOUTHERN PACIFIC CO.	-438171.00
TOLEDO, PEORIA & WESTERN RR CO.	-5762.02
UNION PACIFIC RR CO.	-734938.00
WESTERN PACIFIC RR CO.	-322688.75
BELT RR CO. OF CHICAGO	-5380.01
INDIANA HARBOR BELT RR CO.	-20068.34
TERMINAL RR ASSN. OF ST. LOUIS	-38279.24

Table J-24 (Option 2)

RAILROAD COMPANIES WITH NEGATIVE NET PRESENT VALUE OF FUTURE CASH FLOWS BEFORE ABATEMENT

RAILROAD NAME	NET PRESENT VALUE
BALTIMORE & OHIO RR CO.	-46219.25
BANGOR & AROOSTOOK RR CO.	-28714.85
BOSTON & MAINE CORP.	-142082.37
CANADIAN PACIFIC (IN MAINE)	-2256.00
CHESAPEAKE & OHIO RWY CO.	-37734.31
DELAWARE & HUDSON RWY CO.	-98838.25
DETROIT, TOLEDO & IRONTON RR CO.	-73777.75
ILLINOIS TERMINAL RR CO.	-8205.30
LONG ISLAND RR CO.	-1518995.00
MAINE CENTRAL RR CO.	-15448.11
PITTSBURGH & LAKE ERIE RR CO.	-60928.19
WESTERN MARYLAND RWY CO.	-11903.25
ILLINOIS CENTRAL GULF RR CO.	-476501.06
LOUISVILLE & NASHVILLE RR CO.	-250446.37
SEABOARD COAST LINE RR CO.	-270820.44
ATCHISON, TOPEKA & SANTA FE RWY CO.	-232102.00
BURLINGTON NORTHERN CO.	-839922.56
CHICAGO & NORTHWESTERN TRANSP. CO.	-73494.56
CHICAGO, MILW., ST. PAUL & PACIFIC RR CO.	-652735.12
CHICAGO, ROCK ISLAND & PACIFIC RR CO.	-501638.00
COLORADO & SOUTHERN RWY CO.	-44859.77
FORT WORTH & DENVER RWY CO.	-18733.94
KANSAS CITY SOUTHERN RWY CO.	-31628.19
ST. LOUIS-SAN FRANCISCO RWY CO.	-10384.37
SOUTHERN PACIFIC CO.	-438171.00
TOLEDO, PEORIA & WESTERN RR CO.	-5762.02
UNION PACIFIC RR CO.	-734938.00
WESTERN PACIFIC RR CO.	-322688.75
BELT RR CO. OF CHICAGO	-5380.01
INDIANA HARBOR BELT RR CO.	-20068.34
TERMINAL RR ASSN. OF ST. LOUIS	-38279.24

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Table J-25

RAILROADS AND EQUIPMENT FOR CASH FLOW ANALYSIS

RAILROAD NAME	NOISE SOURCE RETARDERS	 LOAD CELL TEST SITES	 SWITCHERS
1 BO BALTIMORE & OHIO RR CO.	7	0	156
2 BAR BANGOR & AROOSTOOK RR CO.	0	0	3
3 BLE BESSEMER & LAKE ERIE RR CO.	0	1	1
4 BM BOSTON & MAINE CORP.	1	1	66
5 CP CANADIAN PACIFIC (IN MAINE)	0	0	1
6 CV CENTRAL VERMONT RWY CO.	0	0	2
7 CO CHESAPEAKE & OHIO RWY CO.	5	14	98
8 CIM CHICAGO & ILLINOIS MIDLAND RWY CO.	0	0	9
9 CR CONRAIL	32	19	2021
10 DH DELAWARE & HUDSON RWY CO.	0	1	42
11 DTS DETROIT & TOLEDO SHORELINE RR CO.	1	0	7
12 DTI DETROIT, TOLEDO & IRONTON RR CO.	1	0	23
13 EJE ELGIN, JOLIET & EASTERN RWY CO.	1	2	63
14 GTW GRAND TRUNK WESTERN RR CO.	0	1	99
15 ITC ILLINOIS TERMINAL RR CO.	0	1	22
16 LI LONG ISLAND RR CO.	1	1	48
17 MEC MAINE CENTRAL RR CO.	0	2	19
18 NW NORFOLK & WESTERN RWY CO.	7	9	347
19 PLE PITTSBURGH & LAKE ERIE RR CO.	0	1	85
20 RFP RICHMOND, FREDERICKSBURG & POTOMAC RR CO	2	0	16
21 WM WESTERN MARYLAND RWY CO.	1	0	1
22 CCO CLINCHFIELD RR CO.	0	1	13
23 FEC FLORIDA EAST COAST RWY CO.	0	1	11
24 GA GEORGIA RR CO.	0	0	8
25 ICG ILLINOIS CENTRAL GULF RR CO.	4	7	180
26 LN LOUISVILLE & NASHVILLE RR CO.	4	2	168
27 SCL SEABOARD COAST LINE RR CO.	3	6	232
28 SOU SOUTHERN RY. SYSTEM	8	3	210
29 ATSF ATCHISON, TOPEKA & SANTA FE RWY CO.	4	7	178
30 BN BURLINGTON NORTHERN CO.	10	17	562
31 CNW CHICAGO & NORTHWESTERN TRANSP. CO.	1	9	183
32 MILW CHICAGO, MILW., ST. PAUL & PACIFIC RR CO	3	19	235
33 RI CHICAGO, ROCK ISLAND & PACIFIC RR CO.	2	7	164
34 CS COLORADO & SOUTHERN RWY CO.	0	0	14
35 DRGW DENVER & RIO GRANDE WESTERN RR CO.	1	1	35
36 DMIR DULUTH, MISSABE & IRON RANGE RWY CO.	0	1	33
37 DWP DULUTH, WINNIPEG & PACIFIC RWY	0	0	3
38 FWD FORT WORTH & DENVER RWY CO.	0	1	7
39 KCS KANSAS CITY SOUTHERN RWY CO.	0	2	84
40 MKT MISSOURI-KANSAS-TEXAS RR CO.	0	1	51
41 MP MISSOURI PACIFIC RR CO.	3	5	283
42 NWP NORTHWESTERN PACIFIC RR CO.	0	0	13
43 SLSF ST. LOUIS-SAN FRANCISCO RWY CO.	2	1	100
44 SSW ST. LOUIS SOUTHWESTERN RWY CO.	1	0	77
45 SOO SOO LINE RR CO.	0	2	60
46 SP SOUTHERN PACIFIC CO.	8	20	593
47 TM TEXAS MEXICAN RWY CO.	0	0	7
48 TPW TOLEDO, PEORIA & WESTERN RR CO.	0	1	4
49 UP UNION PACIFIC RR CO.	1	4	249
50 WP WESTERN PACIFIC RR CO.	0	1	13
51 AIS ALTON & SOUTHERN RR	1	0	3
52 BRC BELT RR CO. OF CHICAGO	2	0	11
53 IHB INDIANA HARBOR BELT RR CO.	3	1	22
54 TRRA TERMINAL RR ASSN. OF ST. LOUIS	1	1	9
55 UBR UNION RR CO.	1	0	29
56 YS YOUNGSTOWN & SOUTHERN RWY CO.	1	0	2

APPENDIX K

SAMPLE RAILROAD SELECTION PROCEDURE AND ANALYSES

Selection Procedure

In order to obtain the 120 railyards necessary to develop representative site-specific data, approximately 300 yards were initially chosen from the SRI[1] list of 4169 railyards in the U.S. This list has about 80 pages with nearly 50 yards listed on each page, and it is arranged alphabetically by state, city, yard name and railroad company. Thus, as far as yard type and place size are concerned, the listing is random. The procedure for selecting the yards was designed to evenly distribute, as much as possible, the yard sampling throughout the list and, consequently, throughout the United States. Roughly, every fourteenth or fifteenth yard on the list was selected for inclusion in the sampling, until a total of 279 yards had been chosen.

These yards were then classified into the twelve cells, representing combinations of the three place size and four yard type categories. As shown in Table K-1, the resulting distribution of yards among the cells was very uneven. It would have been ideal to classify all the yards on the SRI list into the twelve cells, and then randomly pick the requisite ten yards from each cell, but because of lack of time and resources, a more practical approach was taken and additional yards were selected from the list to augment the deficient cells.

The procedure for selecting the initial 279 yards was modified somewhat to select the additional yards because it was felt that it would be too time consuming to use, given the relatively small overall percentage of some yard types (e.g., hump yards). To assure that these additional yards were uniformly distributed throughout the list, a selection formula was developed for each cell, based upon the number of additional yards required for that cell. For example, cell number 3 needed several additional yards, so the total number of pages in the list (80) was divided by number of yards required (7), which equals eleven; thus, every eleventh page was examined for the required yard type (in this case, hump classification yards in areas with more than 250,000

Table K-1

DISTRIBUTION OF RAILYARDS SELECTED FOR PHOTOGRAPHIC EVALUATION BY PLACE SIZE AND YARD TYPE

	Place Size (Urban Area Population)		
	1 (Small)	2 (Medium)	3 (Large)
Yard Type	<50k People	50k-250k People	>250k People
I. Hump Class	Cell #1 6	Cell #2 0	Cell #3 3
II. Flat Class	Cell #4 42	Cell #5 12	Cell #6 20
III. Flat Ind.	Cell #7 55	Cell #8 5	Cell #9 27
IV. Small Ind.	Cell #10 85	Cell #11 10	Cell #12 14

people) until the requisite number of additional yards had been obtained. In some cases, it was necessary to go through the list several times, starting with a different page number but following the same page-interval formula, in order to find the needed yards.

When all twelve cells had at least ten yards in them, a similar random selection procedure was followed to select ten yards from those cells that had a surplus of yards in them. Table K-2 presents the initial list of 120 railyards, by cell number, which was developed using the procedures described above.

The random selection of 120 railyards, per the procedure described above, resulted in the initial list presented in Table K-2. The selection procedure provided 10 railyards of each of 4 types in each of 3 place size locations for a total of 120 railyards. However, due to lack of photographic imagery, many of the sample railyards were eliminated from the analyses. Therefore, a substitute list was generated as shown in Table K-3.* The final list of the 120 sample railyards analyzed is presented in Table K-4.*

When this list of 120 railyards was given to EPIC for extraction of yard data from aerial imagery, EPIC indicated that 25 of the yards would require substitutes, because nine of the yards had been abandoned, thirteen had inadequate photo coverage, and three for various other reasons. Each cell needed at least one substitute yard, and so basically the same selection procedure was used as was developed for filling the previously described deficient cells. The only difference was, in the case of the cells which had excess yards initially, the substitute yards were chosen from the initial surplus yards (e.g., Cell number 7). At least two additional yards were selected for each cell, and the substitute yard list was prioritized so that the yards at the top of each cell's substitute list were from the same general part of the SRI list as the original yards which they were replacing. (Table K-3 presents the substitute yard list by cell number.)

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*Refer to Appendix D for railroad symbol code.

Table K-2

INITIAL LIST OF SELECTED RAILROAD YARDS

CELL #1

YARD TYPES: Hump Classification PLACE SIZE: 50k People

STATE	CITY	YARD	RR
CO	Grand Junction	Train	DRGW
IL	Markham	Markham SBND	ICG
IN	Elkhart	Robt. P. Young Hump	PC
KY	Russell	Coal Class	CO
KY	Silver Grove	Stevens	CO
OH	Marion	Westbound	EL
OH	Portsmouth	W. B. Hump	NW
PA	Coatesville	Coatesville	RDG
PA	Morrisville	A	PC
WA	Pasco	Train BN	

CELL #2

YARD TYPE: Hump Classification PLACE SIZE: 50k-250k People

STATE	CITY	YARD	R/R
AR	North Little Rock	Crest	MP
AR	Pine Bluff	Gravity	SSW
CO	Pueblo	Train	ATSF
GA	Macon	Brosnan	SOU
NE	Lincoln	E. B. Hump	BN
OR	Eugene	Train	SP
PA	Harrisburg	Enola East	PC
TN	Chattanooga	De Butts	SOU
TN	Knoxville	John Sevier	SOU
TX	Beaumont	Train	SP

CELL #3

YARD TYPE: Hump Classificatiuon PLACE SIZE: 250k People

STATE	CITY	YARD	R/R
FL	Tampa	Rockport	SCL
IL	Chicago	Corwith	ATSF
IL	Chicago	59th Street	PC
IL	East St. Louis	Madison	TRRA
MI	Detroit	Flat Rock	DTS
OH	Columbus	Grandview	PC
OH	Toledo	Lang	DTS
PA	Allentown	Allentown E. Hump	LV
PA	Pittsburgh	Monon Junction	URR
WI	Milwaukee	Airline	CMSPP

Table K-2 (Continued)

CELL #4

YARD TYPE: Flat Classification PLACE SIZE: 50k People

STATE	CITY	YARD	R/R
IL	Belviderf	Train	CNW
IL	Streator	Train	PC
IA	Missouri Valley	Train	CNW
MI	Willow Run	Industrial	PC
MT	Helena	Train	BN
OH	Huron	South	NW
PA	Sayre	Sayre	LV
TX	Cleburne	Cleburne	ATSF
VA	Crewe	Train	NW
WV	Martinsburg	Cumbo	PC

CELL #5

YARD TYPE: Flat Classification PLACE SIZE: 50k-250k People

STATE	CITY	YARD	R/R
CA	Stockton	Mormon	ATSF
LA	Shreveport	Deramus	KCS
ME	South Portland	Rigby	PTM
MA	Lowell	Bleachery	BM
MA	Worcester	Worcester	BM
MI	Bay City	North	DM
OH	Lancaster	Lancaster	CO
OH	Lorain	South	LT
TX	Port Arthur	Train	SP
WA	Spokane	Yardley Train	BN

CELL #6

YARD TYPE: Flat Classification PLACE SIZE: 250k People

STATE	CITY	YARD	R/R
AZ	Tucson	Train	SP
FL	Jacksonville	Simpson	GSF
GA	Atlanta	Howell	SCL
IN	Jasonville	Latta	CMSPP
LA	New Orleans	Oliver	SOU
MI	Detroit	Davison Ave.	DT
MO	St. Louis	12th Street	MP
OH	Dayton	Needmore	BO
OR	Portland	Lake	PRTD
TN	Memphis	Hollywood	ICG

Table K-2 (Continued)

CELL #7

YARD TYPE: Flat Industrial PLACE SIZE: 50k People

STATE	CITY	YARD	R/R
AL	Ensley	Ensley	SOU
CA	E. Pleasanton	Train	SP
FL	Nichols	Dry Rock	SCL
IL	Chicago Heights	Heights	BO
IN	Burns Harbor	Burns Harbor	PC
MS	Durant	Durant	ICG
NE	McCook	Train	BN
NY	Troy	Troy	PC
OH	Washington Ct. Hse.	Train	BO
TX	Great Southwest	Great Southwest	GSW

CELL #8

YARD TYPE: Flat Industrial PLACE SIZE: 50k-250k People

STATE	CITY	YARD	R/R
CT	Stamford	Stamford	PC
FL	Pensacola	Whart	LN
GA	Columbus	Columbus	SCL
IN	Terre Haute	Hulman	CMSPP
MI	Ann Harbor	Ann Arbor	AA
MI	Muskegan	Train	CO
NE	Lincoln	Train	OLB
OH	Hamilton	Wood	BO
OH	Springfield	Int'l Harvester	PC
OR	Salem	Train	BN

CELL #9

YARD TYPE: Flat Industrial PLACE SIZE: 250k People

STATE	CITY	YARD	R/R
CA	San Jose	College Park	SP
IL	Chicago	43rd Street	CRIP
NY	Buffalo	Hamburg Street	EL
NY	New York	28th Street	EL
OH	Cincinnati	West End	LN
OH	Youngstown	McDonald	YN
OK	Tulsa	Lafeber	MIDLV
PA	Philadelphia	Midvale	PC
PA	Pittsburgh	Neville Island	POV
VA	Richmond	Belle Isle	SOU

Table K-2 (Continued)

CELL #10

YARD TYPE: Small Industrial Flat PLACE SIZE: 50k People

STATE	CITY	YARD	R/R
CA	Martell	Train	AMC
GA	Vidalia	Vidalia	SCL
KS	Durand	Train	MP
MD	Owings Mills	Maryland	WM
NY	Olean	Train	EL
PA	Cementon	Cementon	LV
SC	Hampton	Train	SCL
TX	Menard	Train	ATSF
WA	Gold Bar	Train	BN
WY	Pulliam	Train	BN

CELL #11

YARD TYPE: Small Industrial Flat PLACE SIZE: 50k-250k People

STATE	CITY	YARD	R/R
AR	Fort Smith	Train	MP
AR	Little Rock	E. 6th Street	MP
GA	Macon	Old CG	CGA
IL	Joliet	South Joliet	ICG
IL	Rockford	Rockford	CNW
KY	Ownesboro	Doyle	ICG
MN	Duluth	Missabi Jct.	DMIR
MT	Billings	Stock	BN
NC	Durham	Train	DS
PA	Erie	Dock Junction	PC

CELL #12

YARD TYPE: Small Industrial Flat PLACE SIZE: 250k People

STATE	CITY	YARD	R/R
DC	Washington, DC	Ivy City	PC
IL	Chicago	Western Ave.	CMSPP
KY	Louisville	Cane Run	ICG
LA	New Orleans	Harahan	ICG
MO	Kansas City	Mattcon	MATTS
NE	Omaha	Freight House	UP
TX	Austin	Train	MP
TX	Dallas	Cadiz Street	CRIP
TX	Houston	Dollarup	HBT
UT	Salt Lake City	Fourth South	DRGW

Table K-3

LIST OF SUBSTITUTE RAILROAD YARDS

	STATE	CITY	YARD	R/R
CELL "1	CA	Bloomington	West Colton	SP
	NJ	Camden	Pavonia	PC
	NY	Mechanicville	Hump	BM
	IL	Silvis	Silvis	CRIP
	MN	St. Paul	New	CMSPP
	MT	Missoula	Train	BN
	MD	Hagerstown	West	WM
CELL "2	VA	Roanoke	Roanoke	NW
	VA	Alexandria	Potomac	RFP
CELL #3	NY	Syracuse	Dewitt	PC
	MI	Detroit	Junction	PC
	TX	Fort Worth	Centennial Hump	TP
	WA	Seattle	Balmer (Interbay)	BN
	CN	New Haven	Cedar Hill	PC
CELL #4	IL	Flora	Train	BO
	BN	Inner Grove	Train	CRIP
	NJ	Port Reading	Port Reading	RDG
	TX	Gainsville	North	ATSF
	TX	Vanderbilt	Train	MP
CELL #5	NY	Binghamton	YD	DH
	WV	Charleston	Bridge Jct.	Joint
	IN	Evansville	Harwood	ICG
	WI	Green Bay	Train	CMSPP
	TX	Amarillo	Train	CRIP
CELL #6	IA	Des Moines	Bell Ave.	CNW
	MD	Baltimore	Bayview	PC
	AL	Mobile	Beauregard	ICG
CELL #7	GA	Brunswick	Brunswick	SCL
	MI	Livonia	Middlebelt	CO
	NJ	Newark	Brills	CNJ
	AZ	Douglas	Douglas	SP
	VA	Hopewell	Train	SCL
CELL #8	TX	Abilene	Abilene	TP
	MI	Kalamazoo	Train	GTW
	PA	Reading	East Reading	PC
	OH	Akron	Mill Street	EL
	OK	Oklahoma City	Turner	MICT

Table K-3 (Continued)

	STATE	CITY	YARD	R/R
CELL #9	MI	Flint	Torrey	GTW
	KY	Louisville	Union Station	LN
	FL	West Palm Beach	West Palm Beach	WPBT
	MA	Boston	Yard 8	BM
	TN	Nashville	West Nashville	LN
	NY	New York	Westchester Ave.	PC
	OH	Cleveland	East 26th Street	PC
CELL #10	OK	Mobile	Train	SLSF
	MN	Sleepy Eye	Train	CNW
	KS	Hutchinson	Carey	BN
	ID	Sandpoint	Transfer	UP
	AR	Camden	Train	SSW
CELL #11	IA	Waterloo	Train	CNW
	SC	Greenville	South	SOU
	TX	Lubbock	Lubbock	FWD
	GA	Savannah	Roper Mill	CGA
	VA	Petersburg	Broadway	NW
	WI	Racine	Junction	CMSPP
	CA	Modesto	Train	ATSF
CELL #12	TX	Fort Worth	Birds	ATSF
	TX	Houston	Bellaire	SP
	WI	Milwaukee	Fowler	CMSPP
	WI	Milwaukee	Rock Jct.	CMSPP
	IN	Indianapolis	Caren	PC
	NY	Rochester	Charlotte Dock	BO
	OH	Cincinnati	Fairmont	BO
	WA	Seattle	House	UP

Table K-4

RAILYARDS INCLUDED IN EPIC SURVEY

STATE	CITY	YARD	RAIL ROAD	FUNCTION	YARD TYPE
AL	Ensley	Ensley	SOU	Industrial	Flat
AZ	Tucson	Train	SP	Class./Indus.	Flat
AR	Fort Smsith	Train	MP	Small Indus.	Flat
AR	Little Rock	E. 6th Street	MP	Small Indus.	Flat
AR	N. Little Rock	Crest	MP	Class./Indus.	Hump
AR	Pine Bluff	Gravity	SSW	Class./Indus.	Hump
CA	Bloomington	W. Colton	SP	Class./Indus.	Hump
CA	E. Pleasanton	Train	SP	Industrial	Flat
CA	Martell	Train	AMC	Small Indus.	Flat
CA	San Jose	College	SP	Industrial	Flat
CA	Stockton	Mormon	ATSF	Class./Indus.	Flat
CO	Pueblo	Train	ATSF	Class./Indus.	Hump
CA	Stamford	Stamford	PC	Industrial	Flat
FL	Nichols	Dry Rock	SCL	Industrial	Flat
FL	Pensacola	Wharf	LN	Industrial	Flat
FL	Tampa	Rockport	SCL	Class./Indus.	Hump
FL	W. Palm Beach	W. Palm Beach	WPBT	Industrial	Flat
GA	Atlanta	Howell	SCL	Class./Indus.	Flat
GA	Brunswick	Brunswick	SCL	Industrial	Flat
GA	Columbus	Columbus	SCL	Industrial	Flat
GA	Macon	Old CG	CGA	Small Indus.	Flat
GA	Macon	Brosnan	SOU	Class./Indus.	Hump
GA	Savannah	Paper Mill	CGA	Small Indus.	Flat
GA	Vidalia	Vidalia	SCL	Small Indus.	Flat
IL	Chicago	Corwith	ATSF	Class./Indus.	Hump
IL	Chicago	Western Ave.	CMSPP	Small Indus.	Flat
IL	Chicago	43rd Street	CRIP	Industrial	Flat
IL	Chicago	58th Street	PC	Class./Indus.	Hump
IL	Chicago Heights	Heightsd	BO	Industrial	Flat
IL	E. St. Louis	Madison	TRRA	Class./Indus.	Hump
IL	Flora	Train	BO	Classification	Flat
IL	Joliet	South Joliet	ICS	Small Indus.	Flat
IL	Markham	Markham SBND	ICG	Classification	Hump
IL	Streator	Train	PC	Class./Indus.	Flat
IN	Burns Harbor	Burns Harbor	PC	Industrial	Flat
IN	Elkhard	RBIP Young Hump	PC	Class./Indus.	Hump
IN	Evansville	Harwood	ICG	Class./Indus.	Flat
IN	Jasonville	Latta	CMSPP	Class./Indus.	Flat
IN	Terre Haute	Hulman	CMSPP	Industrial	Flat

Table K-4 (Continued)

IA	Des Moines	Bell Avenue	CNW	Class./Indus.	Flat
IA	Missouri Valley	Train	CNW	Class./Indus.	Flat
KS	Durand	Train	MP	Small Indus.	Flat
KY	Owensboro	Doyle	ICG	Small Indus.	Flat
KY	Russell	Coal Class	CO	Industrial	Hump
KY	Silver Grove	Stevens	CCO	Class./Indus.	Hump
LA	New Orleans	Harahan	ICG	Small Indus.	Flat
LA	New Orleans	Oliver St.	SOU	Class./Indus.	Flat
LA	Shreveport	Deramus	KCS	Class./Indus.	Flat
ME	South Portland	Rigby	PTM	Class./Indus.	Flat
MD	Owings Mills	Maryland	WM	Small Indus.	Flat
MA	Boston	Yard 8	BM	Industrial	Flat
MA	Lowell	Bleachery	BM	Class./Indus.	Flat
MA	Worcester	Worcester	BM	Class./Indus.	Flat
MI	Ann Arbor	Ann Arbor	AA	Industrial	Flat
MI	Detroit	Davison Ave.	DT	Class./Indus.	Flat
MI	Detroit	Flat Rock	DTI	Class./Indus.	Hump
MI	Willow Run	Industrial	PC	Class./Indus.	Flat
MN	Duluth	Missabi Jct.	DMIR	Small Indus.	Flat
MN	Inver Grove	Train	CRIP	Class./Indus.	Flat
MN	St. Paul	New	CMSPP	Class./Indus.	Hump
MN	Sleepy Eye	Train	CNW	Small Indus.	Flat
MS	Durant	Durant	ICG	Industrial	Flat
MO	St. Louis	12th Street	MP	Class/Indus.	Flat
MT	Billings	Stock	BN	Small Indus.	Flat
MT	Helena	Train	BN	Class./Indus.	Flat
NE	Lincoln	E. B. Hump	BN	Class./Indus.	Hump
NE	Lincoln	Train	OLB	Industrial	Flat
NE	McCook	Train	BN	Industrial	Flat
NE	Omaha	Freight House	UP	Small Indus.	Flat
NJ	Camden	Pavonia	PC	Class./Indus.	Hump
NY	Binghamton	YD	DH	Class./Indus.	Flat
NY	Buffalo	Hamburg St.	EL	Industrial	Flat
NY	Mechanicville	Hump	BM	Classification	Hump
NY	Olean	Train	EL	Small Indus.	Flat
NY	Syracuse	Dewitt	PC	Classification	Hump
NY	Troy	Troy	PC	Industrial	Flat
OH	Akron	Mill St.	EL	Industrial	Flat
OH	Cincinnati	Fairmont	BO	Small Indus.	Flat
OH	Dayton	Needmore	BO	Class./Indus.	Flat
OH	Hamilton	Wood	HO	Industrial	Flat

Table K-4 (Continued)

OH	Huron	South	NW	Class./Indus.	Flat
OH	Lancaster	Lancaster	CO	Class./Indus.	Flat
OH	Lorain	South	LT	Class./Indus.	Flat
OH	Marion	Westbound	EL	Class./Indus.	Hump
OH	Portsmouth	W.B. Hump	NW	Class./Indus.	Hump
OH	Springfield	Int'l Harv.	PC	Industrial	Flat
OH	Toledo	Lang	DTS	Class./Indus.	Hump
OK	Madill	Train	SLSF	Small Indus.	Flat
OK	Tulsa	Lafeber	MIDLV	Industrial	Flat
OK	Eugene	Train	SP	Class./Indus.	Hump
OR	Portland	Lake	PRTC	Class./Indus.	Flat
OR	Salem	Train	BN	Industrial	Flat
PA	Allentown	Allentown E.	LV	Class./Indus.	Hump
PA	Cementon	Cementon	LV	Small Indus.	Flat
Pa	Harrisburg	Enola West	PC	Class./Indus.	Hump
PA	Philadelphia	Midvale	PC	Industrial	Flat
PA	Pittsburgh	Neville Isl.	POV	Industrial	Flat
PA	Pittsburgh	Monon Jct.	URR	Class./Indus.	Hump
PA	Sayre	Sayre	LV	Class./Indus.	Flat
SC	Greenville	South	SOU	Small Indus.	Flat
SC	Hampton	Train	SCL	Small Indus.	Flat
TN	Chattanooga	De Butts	SOU	Class./Indus.	Hump
TN	Knoxville	John Sevier	SOU	Class./Indus.	Hump
TN	Memphis	Hollywood	ICG	Class./Indus.	Flat
TX	Abilene	Abilene	TP	Industrial	Flat
TX	Austin	Train	MP	Small Indus.	Flat
TX	Cleburne	Cleburne	ATSF	Class./Indus.	Flat
TX	Fort Worth	Birds	ATSF	Small Indus.	Flat
TX	Great S.W.	Great S.W.	GSW	Industrial	Flat
TX	Houston	Bellaire	SP	Small Indus.	Flat
TX	Houston	Dollarup	HBT	Small Indus.	Flat
TX	Lubbock	Lubbock	ATSF	Class./Indus.	Flat
TX	Port Arthur	Train	SP	Class./Indus.	Flat
UT	Salt Lake City	Fourth South	DRGW	Small Indus.	Flat
VA	Crewe	Train	NQ	Classification	Flat
VA	Richmond	Belle Isle	SOU	Industrial	Flat
VA	Roanoke	Roanoke	NW	Class./Indus.	Hump
WA	Gold Bar	Train	BN	Small Indus.	Flat
WA	Seattle	House	UP	Small Indus.	Flat
WI	Milwaukee	Airline	CMSPP	Classification	Hump

Yard Activity Rate Classification

The FRA/SRI railyard study data were used to estimate the classification yard area corresponding to the average traffic rates determined for the low, medium and high activity categories. This was done by using the average railcar length of 21m (69 ft) and distance between parallel classification trucks of 4.6m (15 ft) in conjunction with the number of cars classified per day and the number of classification trucks given by the SRI study for a yard type and traffic category to compute the equivalent length and width, and then the typical area covered by the classification tracks. Thus

$$\text{Equivalent length } (L) = 2 \times \frac{(\text{rail cars/day}) \times (\text{length/car})^{*}}{(\text{number of parallel tracks})}$$

$$\text{Equivalent width } (W) = (\text{number of tracks}) \times (\text{distance between tracks}).$$

$$\text{Typical area covered } (A) = W \times L.$$

The range of typical areas for the average traffic rates for low, medium and high activity traffic rates for low, medium and high activity hump and flat classification yards was also computed in the same manner. This provided 3 ranges (or bandwidths) of areas bracketing the low, medium and high traffic rate yard sizes.

The classification portion dimensions for each of the sample hump and flat classification yards analyzed by EPIC were used to obtain the corresponding classification yard areas. These areas were compared to the previously determined area ranges and thus each yard was placed in one of the traffic rate categories. In this way, the traffic rate categories for

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*The factor of 2 accounts for the switching areas at end of the classified railcar storage area.

26 of the 30 sample hump yards (in cells 1, 2 and 3) were estimated (in the remaining 4 cases the yard dimensions were ambiguous). As a result, 9 of the yards were placed in the low activity category, 9 in medium and 8 in high. The sample flat classification yards were distributed into the 3 traffic rate categories as follows: 12 low, 8 medium and 3 high (for 7 of the 30 sample yards, the dimensions were ambiguous).

Examples of Sample RailYards

The study area boundaries around two of the sample railyards are shown as examples in Figures K-1 and K-2. The corresponding study area land use analyses by EPIC are shown in Figures K-3* and K-4*. Also, typical data of railyard dimensions and noise source locations relative to yard boundaries are shown in Figures K-5 and K-6.

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*Code for symbols in Figures K-3 and K-4:
Y - railroad
R = residential land
C = commercial land
I = industrial land
A = agricultural land
U = undeveloped land
X = distance to residential land use

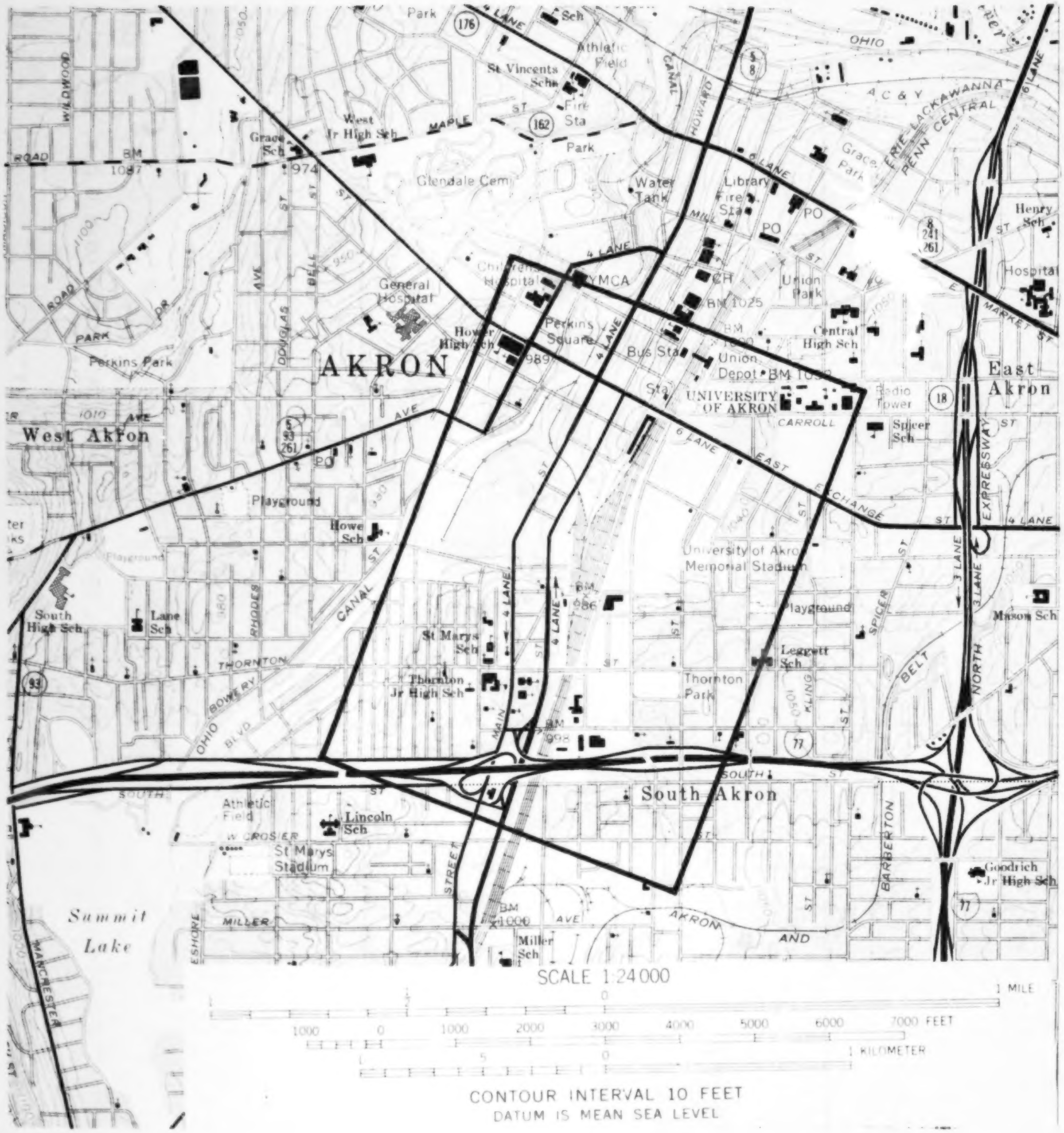

FIGURE K-1. MILL STREET YARD, AKRON, OHIO, WITH STUDY AREA DELINEATED ON U.S.G.S. MAP

Reproduced from best available copy.

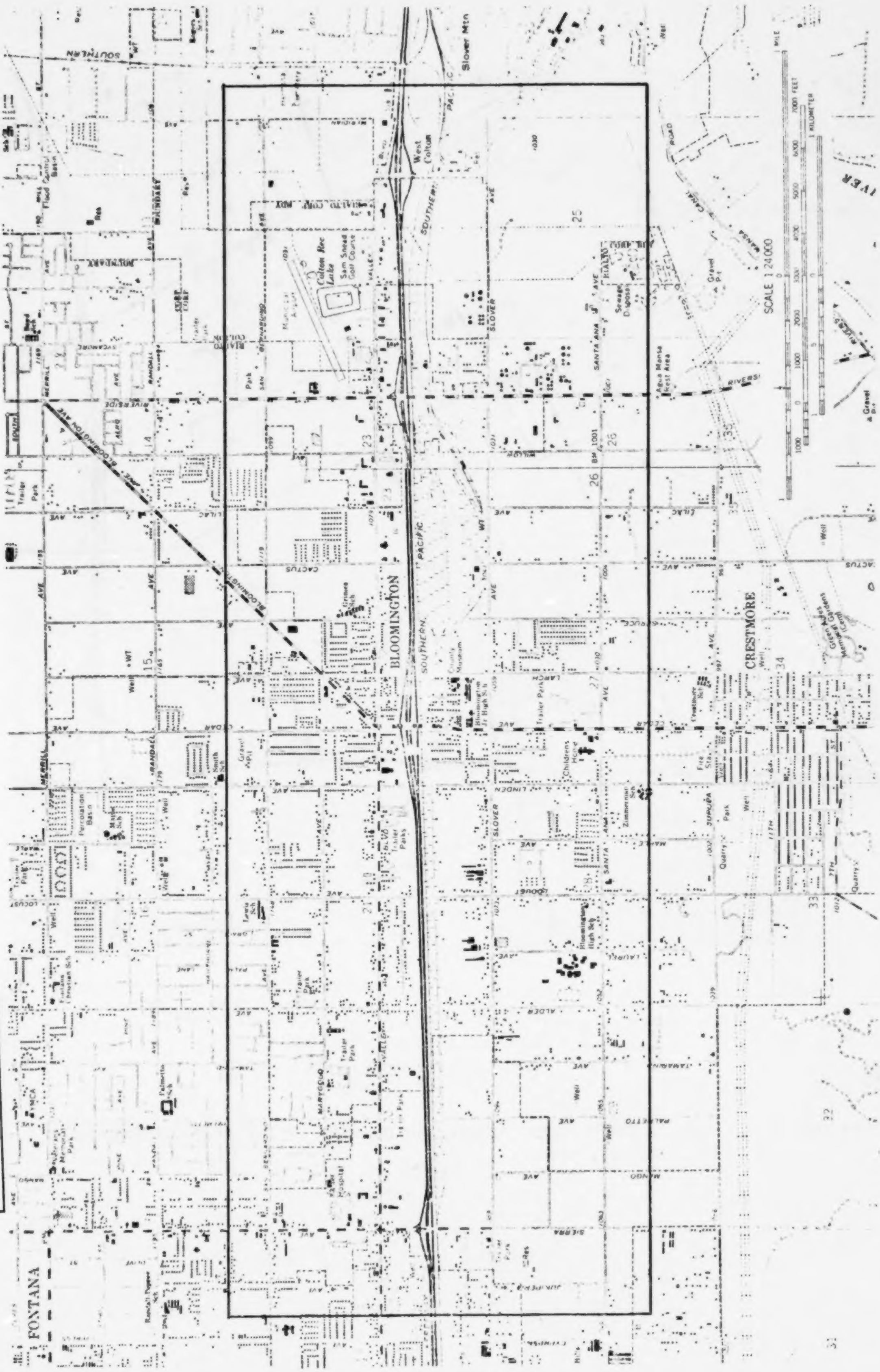

FIGURE K-2. WEST COLTON YARD, BLOOMINGTON, CALIFORNIA, WITH STUDY AREA DELINEATED ON U.S.G.S. MAP

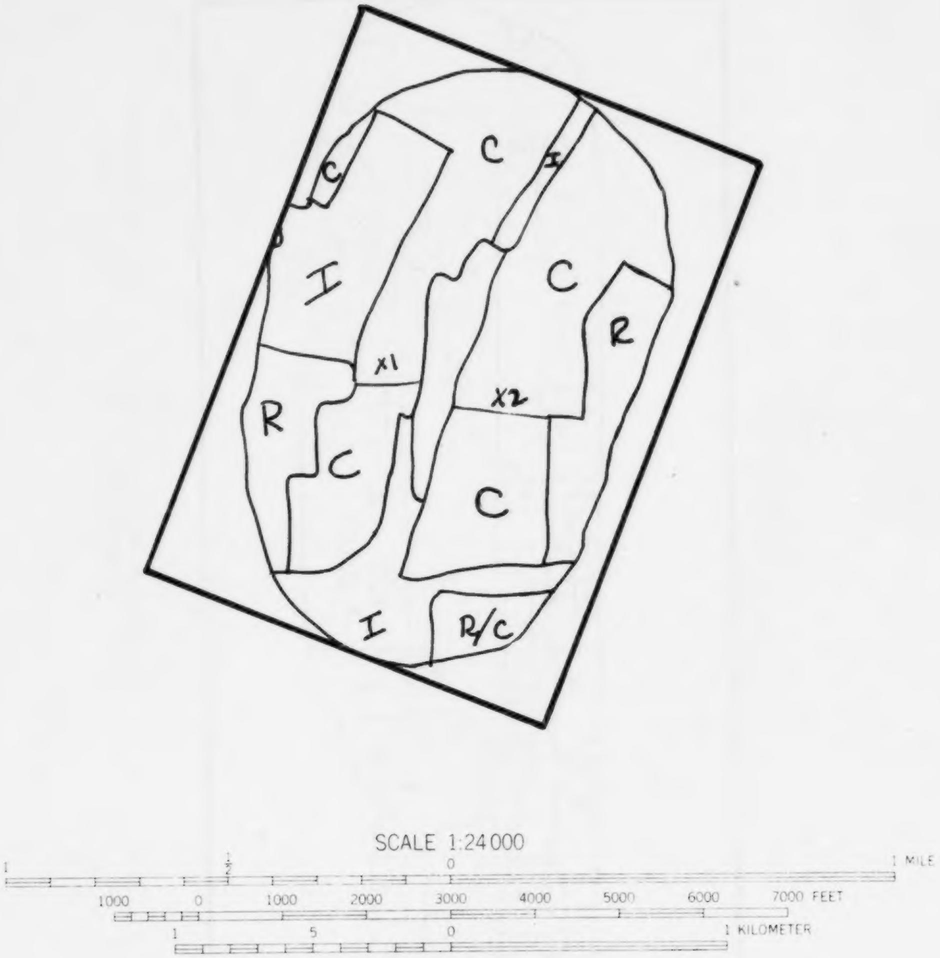

FIGURE K-3. TRACING OVERLAY OF MILL STREET YARDS, AKRON, OHIO

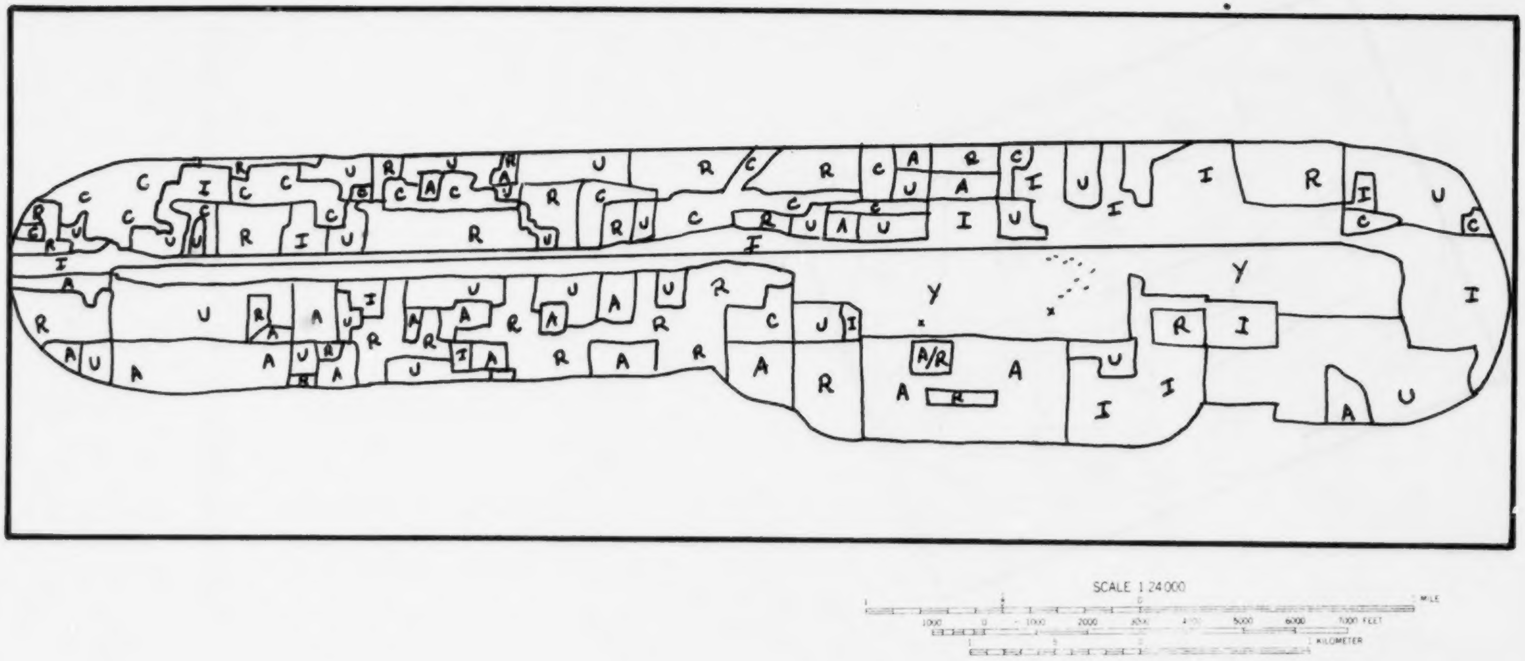

FIGURE K-4. TRACING OVERLAY OF WEST COLTON YARD, BLOOMINGTON, CALIFORNIA

Name Akron, OH., Mill Street Yd., Ind.-Flat

Land Use	Boundary	2000′
A	0%	
B	90%	
C	10%	
D	0%	
E	0%	

Yard Dimensions

Width B-B	Length	Dist. B-R
680′	3080′	X1 - 770′ (SF) X2 - 1100′ (SF)

Noise Sources

Repair Facilities-B	Master Retarder-B	No. Retarder Stages
None	None	

No. R.E.	Dist. B	Dist. B	No. S.E.	Dist. B.	Dist. B.
3	160′	220′	1	250′	150′

FIGURE K-5. DATA SHEET FOR MILL STREET YARDS, AKRON, OHIO

Name California Bloomington, W. Colton, Class./Ind., Hump

Land Use	Boundary	2000′
A	9%	
B	0%	
C	69%	
D	6%	
E	16%	

Yard Dimensions

	Width B-B	Length	Dist. B-R
Class.	1680′ (1290′T-T)	5740′	0′ (S.f.) south of east of R.yard
Receiving	360′	12010′	230′(S.f.) north of west end of R.yard
Departure	1390′	5680′	330′(S.f.) south of departure yard
Total Length		25200′	460′(s.f.) north of central portion

Noise Sources

	Repair Facilities-B	Master Retarder-B	No. Retarder Stages
Engine	1190′, 495′	1 - 430′, 530′	3 & 4 stages
Car	200′, 1450′		

No. R.E.	Dist. B	Dist. B
2	130′	200′
3	165′	200′
2	1350′	360′
3	495′	1190′
1	1390′	330′
1	1190′	500′
3	495′	1190′
3	595′	1120′
7	760′	960′
6	820′	700′
2	860′	860′
33	689.39	815.85

No. S.E.	Dist. B.	Dist. B.
3	165′	1550′
3	200′	1515′
2	1455′	265′
1	1390′	330′
1	1550′	155′
3	760′	960′
13	709.62	1106.92

FIGURE K-6. DATA SHEET FOR WEST COLTON YARDS, BLOOMINGTON, CALIFORNIA

Table K-5

AVERAGE PERCENTAGE LAND USE DISTRIBUTION, ADJACENT TO RAILYARDS, BY YARD TYPE AND PLACE SIZE

		Average Percentage Land Use Distribution Place Size (Number of People)			
Yard Type	Land Use Classification	<50,000	50,000 to 250,000	>250,000	All Population
Hump Classification	Residential	17.2	9.2	9	11.8
	Commercial	6.7	9.1	4.7	6.8
	Agricultural	3.2	11.2	47.6	20.7
	Industrial	40.0	25.4	8.6	24.7
	Undeveloped	33.0	45.2	30.2	36.1
Flat Classification	Residential	22.2	12.5	9.6	14.8
	Commercial	11.0	6.5	12.8	10.1
	Agricultural	1.8	10.0	61.1	24.3
	Industrial	21.5	44.4	5.7	23.9
	Undeveloped	43.5	26.6	11.0	27.0
Flat Industrial	Residential	13.0	16.0	9.0	12.7
	Commercial	8.0	10.0	21.0	13.0
	Agricultural	8.0	1.0	0	3.0
	Industrial	52.0	69.0	51.0	57.3
	Undeveloped	20.0	5.0	9.0	11.3
Small Flat Industrial	Residential	12.0	14.5	16.0	14.2
	Commercial	13.0	6.2	14.0	11.1
	Agricultural	11.0	3.6	0	4.9
	Industrial	36.0	50.2	61.0	49.1
	Undeveloped	28.0	15.3	10.0	17.8
All Yard Types	Residential	16.1	13.1	10.9	13.4
	Commercial	9.7	8.0	13.1	10.3
	Agricultural	6.0	6.5	27.2	13.2
	Industrial	37.4	47.3	31.6	38.8
	Undeveloped	31.1	23.0	15.1	23.1

Table K-6

AVERAGE PERCENTAGE LAND USE DISTRIBUTION, WITHIN 2000′ OF RAILYARD BOUNDARY BY YARD TYPE AND PLACE SIZE

Yard Type	Land Use Classification	Average Percentage Land Use Distribution Place Size (Number of People) <50,000	50,000 to 250,000	>250,000	All Population
Hump Classification	Residential	30	23	28	27
	Commercial	5	10	7	7
	Agricultural	11	14	13	13
	Industrial	17	19	24	20
	Undeveloped	37	35	27	33
Flat Classification	Residential	42	32	31	35
	Commercial	10	10	13	11
	Agricultural	16	15	6	12
	Industrial	11	18	33	21
	Undeveloped	21	24	17	21
Flat Industrial	Residential	22	49	26	32
	Commercial	5	21	22	16
	Agricultural	12	1	0	4
	Industrial	30	21	37	30
	Undeveloped	30	8	15	18
Small Flat Industrial	Residential	31	28	25	28
	Commercial	14	12	14	14
	Agricultural	17	6	0	8
	Industrial	13	33	46	31
	Undeveloped	25	21	14	20
All Yard Types	Residential	31	33	28	31
	Commercial	9	13	14	12
	Agricultural	14	9	5	9
	Industrial	18	23	35	25
	Undeveloped	28	22	18	23

APPENDIX L

DERIVATION OF AVERAGE NOISE LEVELS FOR RAILYARD NOISE SOURCES

APPENDIX L

DERIVATION OF AVERAGE NOISE LEVELS FOR RAILYARD NOISE SOURCES

The representative or average noise levels used in the noise impact health and welfare model are discussed in Sections 4 and 5, and are summarized in Tables 4-1 and 5-4. The bases for determining the average noise level for each type of source are presented below. Reference numbers in this appendix are for those listed at the end of Section 5.

Average Maximum Noise Level:

The references and data shown below were used to obtain the baseline average maximum noise level for master and group retarders:

- EPA-550/9-74-007, 1974 (1)
  Retarder 1
  L_{max} energy ave. = 116 dB* @ 100 ft (30 m); 58 measurements.
  (Range: L_{max} = 90 to 140 dB*)

  Retarder 2
  L_{max} energy ave. = 111 dB* @ 100 ft (30 m); 37 measurements.
  (Range: L_{max} = 90 to 125 dB*)

- Wyle Report 73-5, 1973 (6)
  L_{max} energy ave. = 108 dB* @ 100 ft (30 m); 38 measurements.
  (Range: L_{max} = 96 to 115 dB*)

- BBN RN 2709, 1974 (9)
  MPC Ft. Worth, TX.
  L_{max} energy ave. = 109.5 dB* @ 100 ft (30 m); 113 measurements.
  (Range: L_{max} = 80 to 119 dB*)

  BN Chicago, IL.
  L_{max} energy ave. = 108.5 dB* @ 100 ft (30 m); 164 measurements.

- Composite L_{max} energy ave. ($\overline{L_{max}}$) = 111 dB* @ 100 ft (30 m);
  410 measurements.
  (Range: L_{max} = 80 to 140 dB*)

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*A-weighted sound level.

Average Single Event Level (SEL):

The average SEL is dependent on the typical durations for retarder noise events. However, very little data on retarder SEL values or effective noise event durations (Δt_{eff}) were available. In one reference study, a sample noise-time history indicated durations of 1.5 to 2 sec between the 20 dB down points for clearly definable events.[6] This reference study indicated typical L_{max} = 110 dB* at 100 ft (30 m) with a 10 dB down point duration (t_{10}) of 1 sec and a typical SEL of 107 dB*. This implies that Δt_{eff} = 0.5 sec since:

$$SEL = L_{max} + 10 \log \Delta t_{eff}.$$

A few other data indicated a typical retarder squeal (at 100 ft or 30 m distance) could be represented by an equilateral triangle time-history with a maximum level of 110 dB* and a duration of 3.6 sec for the 30 dB down points (t_{30}).[6,9] This aso results in (Δt_{eff}) = 0.5 sec.

Additional data on retarder noise events were obtained during noise measurements at railyards conducted for the EPA in 1978.[13] Many of the clearly definable individual retarder noise events had triangular time-histories with t_{30} values in the 3 to 6 sec. range (the distances between source and measurement location were not defined). Longer duration noise events (8 to 15 sec) were complex patterns of closely spaced multiple events rather than a single pulse or squeal. It can be shown analytically that (for the single triangular shaped pulse) if t_{30} = 1, 3, 6 or 9 sec, then Δt_{eff} = 0.15, 0.45, 0.9 and 1.35 sec, respectively. Visual examination of the 1978 measurement data indicate typical Δt_{eff} values in the 0.5 sec range (Roseville, Barstow and Brosnan Hump Yards).

Based on these data and other independent analytical comparisons, it is considered that the typical Δt_{eff} is approximately 0.5 sec. Thus, at 100 ft (30 m) distance from the retarder, the typical or average SEL value ($\overline{SEL}$) is 108 dB*.

---

*A-weighted sound level.

Inert Retarders

The inert retarder noise level data were obtained from one reference which presented measured levels for 96 noise events.[6] The ranges of maximum levels measured was from 78 to 101 dB* at 100 ft (30 m), and the energy average maximum level (L_{max}) for the 96 data points was 93 dB*.

Since there were no data available on inert retarder noise event durations, it was assumed that $\Delta t_{eff} = 0.5$ sec (the same as for master and group retarders). Thus the reference or typical SEL value at 100 ft (30 m) was 90 dB*.

Flat Yard Switch Engines

Data were available from only one reference for noise levels of switch engines working in flat yard areas.[6] Maximum noise levels were measured for 30 events during acceleration passbys ("kicking" railcars) which apparently were conducted at throttle setting 1 to 2. The range of maximum noise levels at 100 ft (30 m) was 73 to 92 dB*, and the energy average level (L_{max}) was 83 dB*.

In the noise model it was assumed that $L_{max} = 83$ dB* (at 100 ft or 30 m) was the representative or typical level for all switchers (MS,IS, CSW, CSE and SE) except the hump lead switch engine (HS).

Hump Lead Switch Engine

Only a few data samples were available to indicate the typical noise level for hump lead switch engine passbys.[6] These data indicated that $\overline{L_{max}}$ was in the 76 to 80 dB* range at 100 ft (30 m). Therefore, an $L_{max} = 78$ dB* was assumed for the noise impact model.

---

*A-weighted sound level.

Idling Locomotives

Two references contained numerous measurements of noise levels from a wide variety of types and sizes (HP) of rail locomotives at the stationary idle (throttle setting 0) condition.[2,6] The measurements were obtained at distances of 50 to 150 ft (15.2 to 92 m) in railyards under a variety of operating conditions (including load tests, special tests near repair shops and groups of idling locomotives). These data were examined and, where required, normalized to the noise level of one locomotive at a distance of 100 ft (30 m). In those cases where the measured level was due to a line or group of locomotives, a standard analytical procedure was used to estimate the average level for one locomotive.[6] One of the references presented data for "road engines" and "switch engines" without defining either type of locomotive.[6] The other reference listed the power rating (HP) of the locomotives for which noise levels were measured.[2]

A summary of the data from these two references is presented below:

Idle Noise Levels at 100 ft (30 m)

Ref. 6	Type of Locomotive	Number*	L_{ave}**(dB***)	L_{range}(dB***)
	Road Engine	5	58	
		7	70	66 to 73
		1	69	
	Switch Engine	1	62	
		1	64	
		4	65	63 to 67

---

* Number of data points, or number of locomotives in group.

** Energy average noise level for one equivalent locomotive.

***A-weighted sound level.

Ref. 2	Size of Locomotive	Number*	L_{ave} (dB)**	L_{range} (dB)***
	≥2500 HP	35	68.3	64.5 to 72
		7	68.7	
	<2500 HP	12	65.9	61 to 70
		1	64.5	
		6	68.5	
		1	67.0	
		1	66.5	

* Number of data points

** Energy average noise level, A-weighted.

It was assumed that road haul locomotives were in the ≥2500 HP category, while switch engines were in the <2500 HP category. Then, the energy average levels for the data from the two references were:

L_{ave} (<2500 HP) = 66.4 dB***; 27 samples.

L_{ave} (≥2500 HP) = 68.5 dB***; 55 samples.

However, it appeared that most of the measured levels in this group may have included the effects of reflecting surfaces (repair shop buildings, rail cars and locomotives) and high level background noise. There were several specific measurement cases where the background noise levels were given, and the contribution of reflected noise was calculated.[2,6] On the average the combination of these two effects tended to increase the measured locomotive noise levels by 1.5 dB***. Therefore, in the absence of reflecting surfaces and background noise levels (within 15 dB of the locomotive noise level), the noise levels for idling locomotives (at 100 ft or 30 m) were:

L_{ave} (<2500 HP) = 65 dB***

L_{ave} (≥2500 HP) = 67 dB***

***A-weighted sound level.

In the railyard noise impact model, it was assumed that switching operations were performed by a 50/50 mixture of locomotives above and below 2500 HP. Therefore, the L_{ave} value used in the model for an idling locomotive was 66 dB*.

Load Cell Operations

Noise measurement data for locomotives operating in a stationary condition at high throttle settings (throttle setting 8) were available from 4 references.[1,2,6,9] The locomotives were operating under either a self-load condition or at a load test cell facility. The majority of the data samples (51 out of 59) were contained in one of the references.[2] The size of the locomotives ranged from 1500 to 3600 HP, and the noise levels at 100 ft (30 m) ranged from 84 to 94 dB*. The resulting energy average noise level at 100 ft (30 m) was 90 dB*.

Refrigerator Cars

Noise levels from the diesel engine powered cooling units on refrigerator cars are a function of engine speed and which side of the car the measurement is being made. The cooling units typically operate at either low or high engine speed. Also the noise levels are usually greater on the side of the railcar where the diesel engine is located, as compared to the opposite side where the condenser is located. Several references are available which present a total of approximately 100 samples of refrigerator car noise levels.[6,12,17] However, much of the data is not defined relative to both engine speed and side of railcar (engine vs. condenser). Therefore, only those noise data (about 23 samples) for which specific operating conditions and measurement locations were known were used to derive the representative average noise level for refrigerator cars.[6,17] These data were grouped according to engine speed for both sides of the cooling unit, and the energy average noise level for each group of data was calculated (the noise levels were measured at 50 ft or 15 m):

---

*A-weighted sound level.

High Throttle
Engine side $L = 79.2$ dB*(7 samples)
Condenser side $L = 70.9$ dB*(7 samples)
$L_{ave} = 77^*$dB (both sides)

Low Throttle
Engine side $L = 73.9$ dB*(4 samples)
Condenser side $L = 65.5$ dB*(5 samples)
$L_{ave} = 72^*$dB (both sides)

The weighted (energy) average for both sides at each throttle setting was calculated since the refrigerator cars are likely to be randomly oriented in the railyards, and thus it was assumed that it would be equally likely (over the total number of railyards) for the receiving property areas to be subjected to the high and low noise sides. Also, the recent references indicated that high engine speed operation typically occurred for only 10 minutes per hour.[12] Thus, the weighted energy average level for both speeds and both sides was 73 dB* at 50 ft (15 m). The reference level thus used in the noise impact model was $L = 67$ dB* at 100 ft (30 m).

Railcar Coupling (Impact)

Several references provided noise level data for railcar coupling impact events.[6,9,11] Two of the references which were initially available did not include either coupling speed data correlated to the noise level, or noise event durations from which SEL values could be determined.[6,9] These two references provided 133 noise level samples which indicated a maximum noise level range of 79 to 115 dB* at 100 ft (30 m), with an energy average level of 100 dB*.

Subsequently, however, additional data became available which provided impact noise levels (L_{max} and SEL) correlated to coupling speeds, and which indicated the probability distribution for coupling speeds.[10,11] Assuming that the noise level and speed distributions would hold for all railyards, it was possible to calculate the expected energy average noise level for car impact events. Essentially, the expected level is the integral of the product of the noise-speed and speed-probability functions. Due to the form of the available data, the value of this integral was obtained using probability and noise level values in 1 MPH class intervals according to the equation:

---

*A-weighted sound level.

$$\overline{L}_{exp} = 10 \log \sum_{i} 10^{L_i(v)/10} \times P_i(v) \; ;$$

$L_i(v)$ = energy average maximum noise level for car impact events in each i speed class (1 MPH interval);

$P_i(v)$ = the probability associated with each coupling speed class interval.

The basic data used for this determination consisted of 31 samples of L_{max} and SEL values for coupling noise[11], and 61,000 samples of car coupling speeds.[10] These data are summarized below:

Speed (v) Interval (MPH)	$P_i(v)$[10]	L_i(dB**)[11]	SEL_i(dB**)[11]	
0-1	.001	65.3	58.7	Extrapolated*
1-2	.035	80.9	73.6	
2-3	.092	89.2	81.6	
3-4	.179	92.0	86.2	Calculated from Measured Noise Levels
4-5	.256	95.6	90.8	
5-6	.270	99.7	94.3	
6-7	.101	101.6	96.3	
7-8	.039	103.7	98.5	
8-9	.018	106.1	100.1	
9-10	.007	107.1	102.2	Extrapolated*
10-11	.002	108.5	103.7	
11-12	.001	109.8	105.1	
12-13	.0002	111.0	106.4	
13-14	.0002	112.1	107.6	
14-15	.00007	113.1	108.7	
15-16	.00002	114.0	109.7	
16-17		--	--	
17-18	.00002	115.7	111.6	

---

* The extrapolated data were obtained by extending a smooth curve through the energy average levels derived from the measured levels in each of the speed class intervals from 2 to 7 MPH.

**A-weighted sound level.

The baseline expected noise level values were:

Max L_{exp} = 98.8 dB* at 100 ft (30.5 m).

SEL_{exp} = 93.5 dB* at 100 ft (30.5 m).

In addition, two possible impact noise control options were considered - limiting coupling speeds to 6 MPH, or to 4 MPH. Expected noise level values for these cases were determined by assuming that for the 6 MPH speed limit case, all couplings above 6 MPH would be redistributed into the 5 to 6 MPH interval. And for the 4 MPH speed limit case, all couplings above 4 MPH would be redistributed into the 3 to 4 MPH interval. The results were:

- 6 MPH Speed Limit, Max L_{exp} = 97.3 dB*
  SEL_{exp} = 92.0 dB*

- 4 MPH Speed Limit, Max L_{exp} = 91.7 dB*
  SEL_{exp} = 85.8 dB*

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*A-weighted sound level.

APPENDIX M

POPULATION DENSITY

APPENDIX M

POPULATION DENSITY

In some cases of yards located in scarcely populated areas, the study areas were enlarged to include at least one population centroid. It was indicated by CACI that as long as population within the study area was 500 or more people, the accuracy of the population estimate was at least 10 percent.

The site specific or local average population density is not equal to true residential density since in each study area, the land surface area used to obtain the density value includes the commercial, industrial, agricultural, and undeveloped land. However, the local average density obtained by this procedure reflects more accurately the population impacted than would be the case if the gross average population density for an entire urban area were used. Also, in the health and welfare impact model, the impact is determined according to an integration of density over area so that correct local population is accounted for independent of the micro-distribution of people in the study area.

Since the number of railyards were given according to 4 yard types and 3 place sizes, there were 12 cells or groups of yard samples to be evaluated. The local average population density within the selected study area at each railyard was calculated, and the resulting density ranges obtained for the yard types within each cell and for each place size class are shown in Table M-1.

For the 4 cells (or groups of railyards) in the small place size (less than 50,000 people) class, the local average population densities ranged from 9 to 10,100 people. The population densities around railyards located in the medium place size and large place size classes, respectively, ranged from 90 to 8135 people/sq.mi. and from 4 to 21,594 people/sq.mi.

Table M-1

RANGE OF LOCAL AVERAGE POPULATION DENSITIES AROUND SELECTED RAILYARDS

	Range of Population Density (People/Sq.Mi.)*		
	Place Size (Population Range):		
Yard Type	1. Less than 50,000	2. 50,000 to 250,000	3. Greater than 250,000
Hump Classification	234 to 10,068	90 to 4,520	377 to 21,594
Flat Classification	9 to 2,580	127 to 6,625	4 to 17,507
Flat Classification	143 to 6,833	1,285 to 8,135	39 to 19,604
Small Industrial	12 to 8,169	549 to 4,581	658 to 17,049

---

* Local Average. To convert to people/sq km, multiply by 0.386.

Evaluation of the density data indicated low correlation between yard type and population density, and a wide distribution of numbers of yards throughout the density range for each cell. Therefore, in each place size, the densities for the 40 sample yards were placed into 7 density classes and the number of yards in each density class was counted. This distribution is shown in Table M-2. A weighted average density was computed for the railyards in each of the seven density classes for each place size category. The weighted average density for each class was obtained by summing the corresponding study area and population values for the yards in each density range and dividing the total population by the total area:

$$\text{AVG}\ \rho = \sum_{i} Pi / \sum_{i} Ai$$

The results are shown in Table M-3. These weighted average density values were used to represent the local average population densities for the railyards in each density range.

Table M-2

DISTRIBUTION OF SAMPLE RAILYARDS BY POPULATION DENSITY RANGE

Population Density Range (People/Sq.Mi.)	Place Size less than 50,000 people	Place Size 50,000 to 250,000 people	Population Density Range (People/Sq. Mi.)	Place Size Greater than 250,000 people
<500	8	4	<1000	6
500 to 1000	6	5	1000 to 3000	10
1000 to 2000	13	6	3000 to 5000	13
2000 to 3000	7	7	5000 to 7000	2
3000 to 5000	2	10	7000 to 10,000	2
5000 to 7000	2	4	10000 to 15000	3
7000 to 11000	2	3	15000 to 22000	4

Table M-3

AVERAGE POPULATION DENSITY FOR EACH DENSITY RANGE CLASS

Population Density Range (People/Sq.Mi.)	Place Size less than 50,000 people	Place Size 50,000 to 250,000 people	Population Density Range (People/Sq. Mi.)	Place Size Greater than 250,000 people
<500	190	230	<1000	420
500 to 1000	780	690	1000 to 3000	1480
1000 to 2000	1580	1470	3000 to 5000	3880
2000 to 3000	2510	2390	5000 to 7000	5750
3000 to 5000	4070	4050	7000 to 10000	8540
5000 to 7000	5810	5920	10000 to 15000	11700
7000 to 11000	9480	7480	15000 to 22000	19540

Table M-4

DISTRIBUTION OF HUMP YARDS BY PLACE SIZE, TRAFFIC RATE CATEGORY AND POPULATION DENSITY RANGE

Place Size (Thousands of People)	Population Density Range (People/Mile^2)	Number of Yards Traffic Rate Category			
		Low	Medium	High	Total
50	<500	4	4	3	11
	500-1000	3	3	2	8
	1000-2000	6	6	4	16
	2000-3000	3	3	2	8
	3000-5000	1	1	1	3
	5000-7000	1	1	1	3
	7000-11000	1	1	1	3
	Total	19	19	14	52
50-250	<500	2	1	1	4
	500-1000	2	2	1	5
	1000-2000	2	2	1	5
	2000-3000	2	2	1	5
	3000-5000	4	3	2	9
	5000-7000	1	1	1	3
	7000-11000	1	1	1	3
	Total	14	12	8	34
250	<1000	2	2	1	5
	1000-3000	3	4	2	9
	3000-5000	4	5	3	12
	5000-7000	1	1	1	3
	7000-10000	1	1	1	3
	10000-15000	1	1	0	2
	15000-22000	1	2	1	4
	Total	13	16	9	38
	Total				124

Table M-5

DISTRIBUTION OF FLAT CLASSIFICATION YARDS BY PLACE SIZE, TRAFFIC RATE CATEGORY AND POPULATION DENSITY RANGE

Place Size (Population Range)	Population Density Range (People/Mile^2)	Number of Yards By Traffic Rate Category Low	Medium	High	Total
1. Less than 50,000	<500	64	41	21	126
	500-1000	48	31	16	95
	1000-2000	103	65	33	201
	2000-3000	58	37	19	114
	3000-5000	16	10	5	31
	5000-7000	16	10	5	31
	7000-11000	16	10	5	31
	Total	321	204	104	629
2. 50,000 to 250,000	<500	14	9	4	27
	500-1000	20	12	7	39
	1000-2000	20	12	7	39
	2000-3000	20	12	7	39
	3000-5000	39	24	13	76
	5000-7000	11	7	3	21
	7000-11000	11	7	3	21
	Total	135	83	44	262
3. Greater than 250,000	<1000	17	10	6	33
	1000-3000	29	18	9	56
	3000-5000	34	21	11	66
	5000-7000	9	6	3	18
	7000-10000	6	3	2	11
	10000-15000	8	5	2	15
	15000-22000	12	7	4	23
	Total	115	70	37	222
	Total				1113

Table M-6

DISTRIBUTION OF INDUSTRIAL FLAT YARDS BY PLACE SIZE AND POPULATION DENSITY RANGE

Place Size (Thousands of People)	Population Density Range (People/Mile^2)	Number of Yards
50	<500	170
	500-1000	128
	1000-2000	272
	2000-3000	153
	3000-5000	42
	5000-7000	42
	7000-11000	42
		849
50-250	-500	24
	500-1000	36
	1000-2000	36
	2000-3000	36
	3000-5000	69
	5000-7000	19
	7000-11000	19
		239
250	<1000	44
	1000-3000	73
	3000-5000	88
	5000-7000	23
	7000-10000	15
	10000-15000	21
	15000-22000	29
		293
	Total	1381

Table M-7

DISTRIBUTION OF SMALL INDUSTRIAL FLAT BY PLACE SIZE AND POPULATION DENSITY RANGE

Place Size (Thousands of People)	Population Density Range (People/Mile^2)	Number of Yards
50	<500	253
	500-1000	189
	1000-2000	404
	2000-3000	227
	3000-5000	63
	5000-7000	63
	7000-11000	63
	Total	1262
50-250	<500	13
	500-1000	20
	1000-2000	20
	2000-3000	20
	3000-5000	38
	5000-7000	11
	7000-11000	11
	Total	133
250	<1000	23
	1000-3000	39
	3000-5000	47
	5000-7000	12
	7000-11000	8
	11000-15000	11
	15000-22000	16
	Total	156
	Total	1551

```
                                   DEMOGRAPHIC PROFILE REPORT          PAGE  1

MILL ST. YARD
AKRON, OHIO                           * * * * * * * * * * * * * * * * * * * * * * * * * *
                                      *                        LATEST    CHANGE *
             DEG MIN SEC              *                                  FROM 70 *
LATITUDE      41   7  30              * 1977 POPULATION          3691      -893 *
LONGITUDE     81  30   0              * 1977 HOUSEHOLDS          1420      -166 *
                                      * 1977 PER CAP INCOME    $ 3895    $ 1064 *
 4 POINT POLYGON                      *                                         *
                                      *    ANNUAL COMPOUND GROWTH  -3.0%        *
WEIGHTING PCT   100%                  * * * * * * * * * * * * * * * * * * * * * * * * * *

                                   1970 CENSUS DATA

POPULATION                 AGE AND SEX
TOTAL         4584   100.0%                  MALE                FEMALE         TOTAL
WHITE         3328    72.6%  0-5         227   10.0%          234   10.1%       10.1%
NEGRO         1253    27.3%  6-13        320   14.1%          320   13.8%       14.0%
OTHER            3     0.1%  14-17       203    9.0%          183    7.9%        8.4%
                             18-20       201    8.9%          177    7.6%        8.2%
SPAN            13     0.3%  21-29       388   17.1%          320   13.8%       15.4%
                             30-39       162    7.1%          207    8.9%        8.0%
                             40-49       231   10.2%          196    8.5%        9.3%
FAMILY INCOME (000)          50-64       273   12.0%          371   16.0%       14.0%
$0-5           334    32.0%  65 +        262   11.6%          311   13.4%       12.5%
$5-7           148    14.2%  TOTAL      2267                 2319
$7-10          259    24.8%  MEDIAN(AGE)     25.2                  27.9        26.4
$10-15         225    21.6%
$15-25          70     6.7% HOME VALUE (000)          OCCUPATION
$25-50           4     0.4% $0-10       198   44.9%   MGR/PROF       209   13.9%
$50 +            4     0.4% $10-15      208   47.2%   SALES           56    3.7%
TOTAL         1044           $15-20      34    7.7%   CLERICAL       250   16.6%
                             $20-25       0    0.0%   CRAFT          199   13.2%
AVERAGE     $ 8082           $25-35       1    0.2%   OPERTIVS       404   26.8%
MEDIAN      $ 7463           $35-50       0    0.0%   LABORER         85    5.6%
                             $50 +        0    0.0%   FARM             1    0.1%
                             TOTAL      441           SERVICE        275   18.3%
RENT                                                  PRIVATE         27    1.8%
$0-100         788    80.9% AVERAGE $10524
$100-150       162    16.6% MEDIAN  $10529
$150-200        19     2.0% % OWNER   31.2            EDUCATION  ADULTS > 25
$200-250         4     0.4%                           0-8            819   36.4%
$250 +           1     0.1%                           9-11           653   29.0%
TOTAL          974           AUTOMOBILES              12             627   27.9%
                             NONE       532   33.7%   13-15           73    3.2%
AVERAGE     $   75           ONE        760   48.2%   16 +            76    3.4%
MEDIAN      $   62           TWO        230   14.6%
% RENTER      68.8           THREE+      55    3.5%
                                                      HOUSEHOLD PARAMETERS
                                                      FAM POP       3714   81.0%
UNITS IN STRUCTURE          HOUSEHOLDS WITH:          INDIVIDS       636   13.9%
1              803   52.0%  TV         1365   86.1%   GRP QTRS       234    5.1%
2              275   17.8%  WASHER     1031   65.0%   TOT POP       4584
3-4            114    7.4%  DRYER       454   28.6%
5-9             81    5.2%  DISHWSH      56    3.5%  NO OF HH'S        1586
10-49          209   13.5%  AIRCOND     144    9.1%  NO OF FAM'S       1098
50 +            63    4.1%  FREEZER     249   15.7%  AVG HH SIZE        2.7
MOBILE           0    0.0%  2 HOMES      49    3.1%  AVG FAM SIZE       3.4

                                                                       CACI,INC
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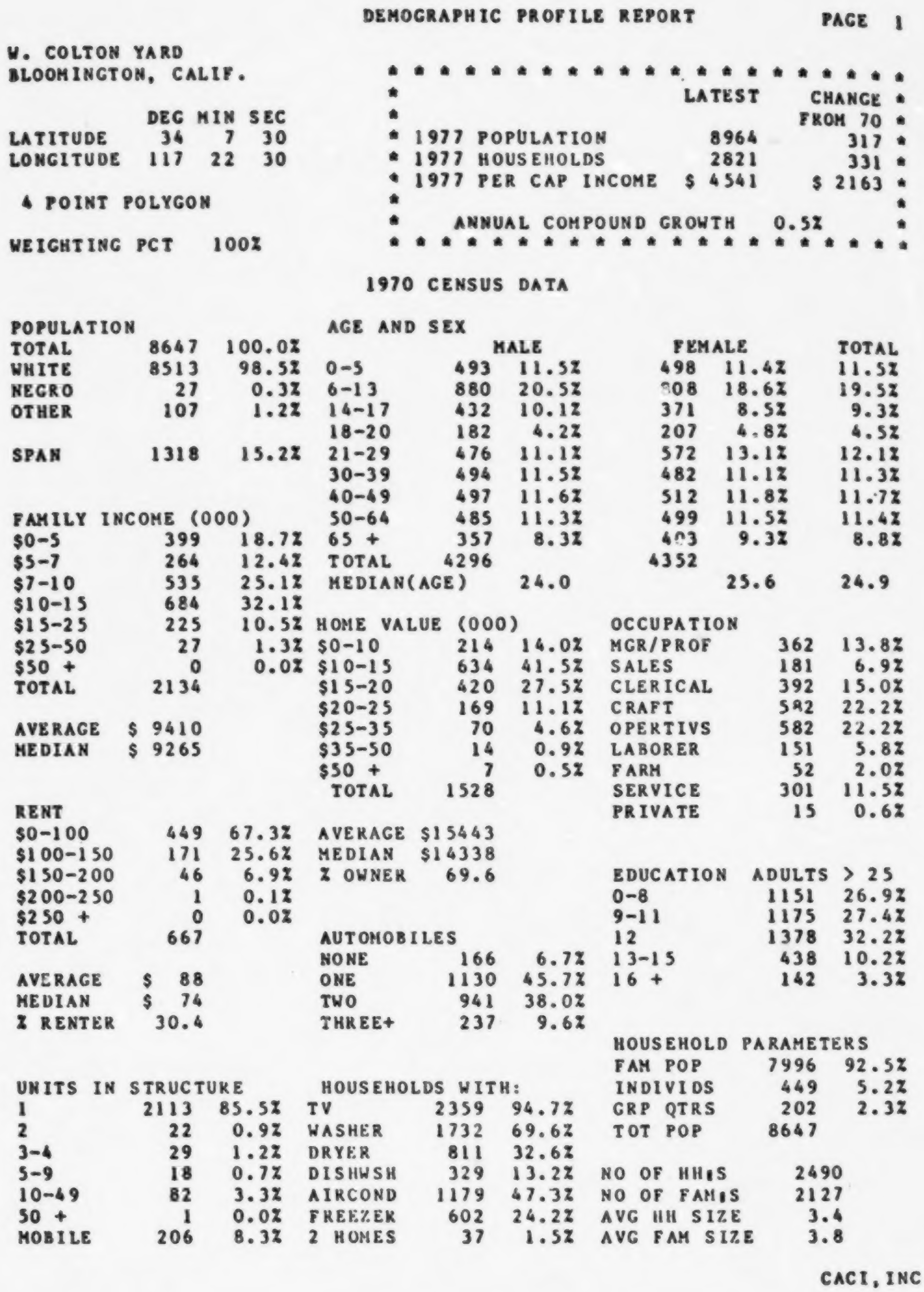
FIGURE M-1. DEMOGRAPHIC PROFILE REPORT OF MILL STREET
YARDS, AKRON, OHIO



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                                 DEMOGRAPHIC PROFILE REPORT          PAGE  1

W. COLTON YARD
BLOOMINGTON, CALIF.              * * * * * * * * * * * * * * * * * * * * *
                                 *                       LATEST    CHANGE *
               DEG MIN SEC       *                                 FROM 70 *
LATITUDE        34   7  30       * 1977 POPULATION        8964       317 *
LONGITUDE      117  22  30       * 1977 HOUSEHOLDS        2821       331 *
                                 * 1977 PER CAP INCOME  $ 4541    $ 2163 *
 4 POINT POLYGON                 *                                       *
                                 *    ANNUAL COMPOUND GROWTH   0.5%      *
WEIGHTING PCT    100%            * * * * * * * * * * * * * * * * * * * * *

                                 1970 CENSUS DATA

POPULATION                  AGE AND SEX
TOTAL        8647   100.0%                 MALE               FEMALE          TOTAL
WHITE        8513    98.5%  0-5         493   11.5%        498   11.4%        11.5%
NEGRO          27     0.3%  6-13        880   20.5%        808   18.6%        19.5%
OTHER         107     1.2%  14-17       432   10.1%        371    8.5%         9.3%
                            18-20       182    4.2%        207    4.8%         4.5%
SPAN         1318    15.2%  21-29       476   11.1%        572   13.1%        12.1%
                            30-39       494   11.5%        482   11.1%        11.3%
                            40-49       497   11.6%        512   11.8%        11.7%
FAMILY INCOME (000)         50-64       485   11.3%        499   11.5%        11.4%
$0-5          399    18.7%  65 +        357    8.3%        403    9.3%         8.8%
$5-7          264    12.4%  TOTAL      4296               4352
$7-10         535    25.1%  MEDIAN(AGE)      24.0                25.6         24.9
$10-15        684    32.1%
$15-25        225    10.5%  HOME VALUE (000)          OCCUPATION
$25-50         27     1.3%  $0-10       214   14.0%   MGR/PROF        362   13.8%
$50 +           0     0.0%  $10-15      634   41.5%   SALES           181    6.9%
TOTAL        2134           $15-20      420   27.5%   CLERICAL        392   15.0%
                            $20-25      169   11.1%   CRAFT           582   22.2%
AVERAGE   $ 9410            $25-35       70    4.6%   OPERTIVS        582   22.2%
MEDIAN    $ 9265            $35-50       14    0.9%   LABORER         151    5.8%
                            $50 +         7    0.5%   FARM             52    2.0%
                             TOTAL     1528           SERVICE         301   11.5%
RENT                                                  PRIVATE          15    0.6%
$0-100        449    67.3%  AVERAGE $15443
$100-150      171    25.6%  MEDIAN  $14338
$150-200       46     6.9%  % OWNER   69.6            EDUCATION  ADULTS > 25
$200-250        1     0.1%                            0-8            1151   26.9%
$250 +          0     0.0%                            9-11           1175   27.4%
TOTAL         667           AUTOMOBILES               12             1378   32.2%
                            NONE        166    6.7%   13-15           438   10.2%
AVERAGE    $   88           ONE        1130   45.7%   16 +            142    3.3%
MEDIAN     $   74           TWO         941   38.0%
% RENTER     30.4           THREE+      237    9.6%
                                                      HOUSEHOLD PARAMETERS
                                                      FAM POP        7996   92.5%
UNITS IN STRUCTURE          HOUSEHOLDS WITH:          INDIVIDS        449    5.2%
1            2113    85.5%  TV         2359   94.7%   GRP QTRS        202    2.3%
2              22     0.9%  WASHER     1732   69.6%   TOT POP        8647
3-4            29     1.2%  DRYER       811   32.6%
5-9            18     0.7%  DISHWSH     329   13.2%   NO OF HH:S      2490
10-49          82     3.3%  AIRCOND    1179   47.3%   NO OF FAM:S     2127
50 +            1     0.0%  FREEZER     602   24.2%   AVG HH SIZE      3.4
MOBILE        206     8.3%  2 HOMES      37    1.5%   AVG FAM SIZE     3.8

                                                                       CACI,INC
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FIGURE M-2. DEMOGRAPHIC PROFILE REPORT OF WEST COLTON YARD, BLOOMINGTON, CALIFORNIA

APPENDIX N

SOURCE ACTIVITY AND NOISE LEVEL

APPENDIX N

SOURCE ACTIVITY AND NOISE LEVELS

Source Activity Levels

A significant portion of the yard activity data used as input for the railyard health/welfare impact model was based on information presented in a railroad yard survey conducted for DOT in 1976[1]. In this study, yard activity was presented according to yard type, function and level of activity for hump and flat railyards. These data have been extracted and presented in Tables N-1, N-2, N-3, and N-4. The activity data were used to develop the general noise generation and propagation equations for each source identified. Stationary sources such as groups of retarders were modeled as a single virtual source placed at the geometric center of the grouping. However, since the EPIC survey of 120 railyards indicated considerable variation in the geometric configuration of the 4,169 railyards, the exact location for each noise source relative to its corresponding yard boundary cannot be determined. However, the railyard survey did result in the identification of representative railyard dimensions.

Hump yard complexes are typically composed of yard areas with three separate functions: receiving, classification and departure. In general, specific activities and functions are performed in each component yard and thus, the different yard noise sources are located by function in the component yards. These noise source distributions within the component yards are presented in Table N-5.

There is a high degree of uncertainty concerning the location of individual noise sources such as idling locomotives, refrigeration cars and load test areas within the railyards. Refrigerator cars and idling locomotives could possibly be found in all yard areas. Load test facilities are usually located between or to one side of the yard areas.

Classification flat yards also have areas similar to hump yards which are differentiated by the specific function performed. Except for retarders,

Table N-1

ACTIVITY DESCRIPTORS AND TRAFFIC PARAMETERS FOR HUMP RAILYARDS

Yard Activity Descriptors	Yard Activity Level:		
	Low	Medium	High
Inbound Road-Haul Trains Per Day	8	14	27
Outbound Road-Haul Trains Per Day	8	14	25
Local Trains Dispatched Per Day	2	3	5
Makeup Train Operations* Per Day	32	84	150
Number of Classification Tracks	26	43	57
Number of Receiving Tracks	11	11	13
Number of Departure Tracks	9	12	14
Capacity of Classification Yard (Cars)	1447	1519	2443
Capacity of Receiving Yard (Cars)	977	1111	1545
Capacity of Departure Yard (Cars)	862	969	1594
No. of Cars Per Classification Track*	56	35	43
No. of Cars Per Receiving Track*	89	101	119
No. of Cars Per Departure Track*	96	81	114
Number of Cars Classified Per Day	689	1468	2386
Average Outbound Road-Haul Cars Per Train*	79	75	92
Average Local Cars Per Train	43	83	63
Hump Engine Work Shifts Per Day	3	5	6
Makeup Engine Work Shifts Per Day	3	6	11
Local Makeup Train Operations Per Day*	2	18	20
Industrial and Roustabout Engine Work-Shifts Per Day	4	3	14

---

*Computed From Yard Activity Data.[1]

Table N-2

ACTIVITY DESCRIPTORS AND TRAFFIC PARAMETERS FOR FLAT CLASSIFICATION AND CLASSIFICATION/INDUSTRIAL RAILYARDS

Yard Activity Descriptors	Yard Activity Level:		
	Low	Medium	High
Inbound Road-Haul Trains Per Day	3	6	10
Outbound Road-Haul Trains Per Day	3	7	11
Local Trains Dispatched Per Day	2	3	2
Makeup Train Operations* Per Day	12	28	44
Number of Classification Tracks	14	20	25
Standing Capacity of Classification Yard	653	983	1185
Number of Cars Classification Per Day	288	711	1344
Switch Engine Work-Shifts Per Day	4	7	10
Maximum No. of Cars Per Classification Track*	47	49	47
Average Outbound Road-Haul Train Cars Per Day*	73	68	86
Local Train Makeup Operations Per Day*	2	3	8
Industrial and Roustabout Work-Shifts Per Day	2	4	6

---

*Computed From Yard Activity Data.[1]

Table N-3

TRAFFIC PARAMETERS FOR FLAT INDUSTRIAL YARDS

Yard Activity Descriptors	Yard Activity Level
Inbound Road-Haul Trains Per Day	1
Outbound Road-Haul Trains Per Day	1
Local Trains Dispatched Per Day	1
Cars Switched Per Day	140
Switch Engine Work-Shifts Per Day	3

Table N-4

TRAFFIC PARAMETERS FOR SMALL INDUSTRIAL FLAT YARDS

Yard Activity Descriptors	Yard Activity Level
Inbound Local Trains Per Day	1
Outbound Local Trains Per Day	1
Cars Switched Per Day	30
Switch Engine Work-Shifts Per Day	1

Table N-5

HUMP YARD NOISE SOURCE GROUPINGS AND DISTRIBUTION BY COMPONENT YARD TYPE*

Receiving Yard		Classification Yard		Departure Yard	
Source Location (a) Area	Hump Switchers Inbound Trains	Source Location (b) Area	Retarders (Master and Group) Idling Locomotives Load Tests Car Impacts	Source Location (d) Area	Makeup Switchers Industrial Switchers Outbound Trains
		Source Location (c) Area	Inert Retarders Refrigeration Cars Cap Impacts		

---

*Except for retarders, source operations and distribution are similar for classification flat yards.

which are not usually found in flat yards, the distribution of sources is similar to that shown for hump yards in Table N-5. However, the other flat yards do not perform all of the functions performed in the classification yards and the noise source types and operation areas will be distributed differently. Discussion with rail industry personnel indicated that, in general, switch engines operate at each end of the yard, and the other sources are located inside the main yard area. The noise source location areas for industrial and small industrial flat yards are indicated in Table N-6.

Source Noise Levels

A noise generation equation, or model, has been developed for each identified yard noise source. The yard noise sources are categorized as either moving or stationary. The noise generation equations are developed in terms of L_{dn} for all sources.

The L_{dn} value for each yard source is computed using the empirical data base on railyard source noise levels obtained from equipment and facility noise surveys and measurement studies, and from the yard activity data study.[4,5] A discussion of the data used in estimating the noise generated by each railyard source is presented below.

For yard activities or operations which are performed on a 24-hour per day basis, the number of occurrences or level of yard activity was indicated by rail industry consultants to be distributed uniformly during the daytime and nighttime periods.

Hump Yard Noise Sources

1. Inbound/Outbound Road-Haul and Local Train Operations

Based on average train lengths and power requirements, it was assumed that the local and road-haul trains entering and leaving the yard complex

Table N-6

INDUSTRIAL AND SMALL INDUSTRIAL FLAT YARD NOISE SOURCE GROUPINGS

Industrial		Small Industrial	
	Noise Source		Noise Source
Area (a)	Inbound Trains Switch Engines	Area (a)	Inbound Trains Switch Engine
Area (b)	Car Impacts Outbound Trains	Area (b)	Car Impacts Outbound Trains

are powered by one and three engines, respectively. Train operations were modeled as moving point sources and were assumed to take place within the receiving and departure yard components at a speed of approximately 5 MPH. The number of local and outbound road-haul train operations were combined and treated as a single source type. The number of train operations for each the hump yard activity categories is shown in Table N-1. The train arrivals and departures were uniformly distributed over the daytime and nighttime periods in accordance with the opinion regarding uniform distribution of rail operations by rail industry personnel. Adjustments were made to the L_{dn} values to account for short periods of high-throttle operation and multiple engine configurations.

2. Hump Switch Engine Operations

Hump engine operations were modeled as moving point sources which operate in the receiving yard component of the hump yard complex at a speed of approximately four miles per hour. In determining the number of engine pass-bys it was assumed that the average cut of cars to be humped contained 50 cars, since that is the practical limit indicated for a single switch engine. The number of pass-bys per hump engine "trick" (work-shift) is computed by dividing the average number of cars classified per hump engine trick by 50 and multiplying by two. The factor of two accounts for the number of passes required by each hump operation, one to get into position to push the cut of cars and another to perform the push.

As an example, the computation of the number of hump engine pass-bys for the low activity category hump yard will be presented. Table N-1 shows that on a daily basis, there are 689 cars classified by three hump engine tricks. It is assumed that the yard operates 24-hours per day with two tricks during the daytime period and one during the nighttime period, giving an average number of cars classified per hump engine trick of 230. The number of pass-bys per hump engine per shift is therefore equal to nine (2 x 230/50). For the medium and high traffic activity hump yards the number of pass-bys per engine trick is approximately 20 to 32, respectively.

3. Retarders - Master, Group, Intermediate and Track

The master, group, intermediate and track retarders were modeled as a grouped point source located at the geometric center of the retarders. The L_{dn} resulting from cars passing through the retarders is determined from the number of cars classified per day, number of retarders passed by each car and the percentage of cars which cause retarder noise events. Examination of the available data indicated that on the average each car classified passes two retarders, and that retarder squeal occurs approximately 50 percent of the time. Using the number of cars classified per day for the low, medium and high traffic activity hump yards as shown in Table N-1, the number of retarder noise events per day is 700, 1500 and 2400, respectively.

4. Inert Retarders

Inert retarders were also modeled as a grouped point source located at the geometric center of the retarders. In the absence of any data, it was assumed that each car leaving the classification yard passes a retarder and that approximately 85 percent produce a noise event. It was also assumed that the total number of cars passing the retarders is equal to the number of cars classified per day.

5. Car Impacts

Car impacts were modeled as two groups of stationary point sources located in the classification yard component of the hump yard complex. It was assumed that the total number of car impacts is equal to one-half the number of cars classified per day (see Table N-1), and that the impact noise events were evenly distributed during day and night periods.[6] The final section of this appendix discusses the basis for the impact event rate.

6. Makeup, Industrial and Other Switch Engine Operations

Makeup, industrial and other switch engine operations were modeled as moving point sources which operate in the departure yard component of the hump yard complex at a speed of approximately four miles per hour. It was assumed that the total number of cars leaving the classification yard component per day (assumed equal to the number classified per day) is removed in such a way so that an equal number of cars is handled by each switch engine work shift. Therefore, the number of cars handled per work shift is equal to the total number of cars classified divided by the total number of work shifts. Assuming that 10 cars are handled per switch engine operation, the number of pass-bys per work shift was computed by dividing the number of cars handled per work shift by 10 and, assuming round trips are performed, multiplying the result by 2. The total number of pass-bys per day was determined by multiplying the number of pass-bys per work shift by the total number of work shifts.

7. Idling Locomotives and Refrigeration Cars

Both idling locomotives and refrigeration cars were modeled as grouped point sources located in the classification yard component. However, the baseline L_{dn} was developed from a truncated line source model which transformed the line of point sources into a grouped or virtual point source. This was considered appropriate since the sources may be grouped in a square or rectangular pattern. The resulting expression which accounts for the number of sources and rows, and extra air and ground absorption is given by:

$$L_{dn} = L_{eq_H} + 10 \log \left| \frac{1}{24}(NH_d + 10NH_n) \right| + 8 \log(1.33N_l) - 20 \log(\frac{D}{D_o})$$
$$+ 10 \log(NR) - K(D)$$

where L_{dn} = baseline day-night average noise level, dB

L_{eq_H} = average noise level (per 1-hour period) of a single locomotive or refrigeration car at a distance of 100 feet (30 m), dB

N_l = number of locomotives or refrigeration cars per row

NH_d and NH_n = number of hours of operation during daytime (d) and nighttime (n)

NR = number of rows of locomotives or refrigeration cars

D_o = 100 feet (30 m)

D = distance from source to yard boundary

$K(D)$ = air and ground absorption

Based on the number of locomotives and refrigeration cars in the rail company inventory, the number of rows and the number of idling locomotives and refrigeration cars per row assumed for each hump yard traffic category are shown below:[1,2]

TRAFFIC RATE CATEGORY	IDLING LOCOMOTIVES NUMBER OF ROWS	IDLING LOCOMOTIVES NUMBER PER ROW	REFRIGERATION CARS NUMBER OF ROWS	REFRIGERATION CARS NUMBER PER ROW
Low	2	2	2	5
Medium	3	2	4	5
High	3	2	6	5

8. Locomotive Engine Load Tests

Locomotive load tests were modeled as stationary point sources located in the classification yard component. It was assumed that load tests are conducted at high activity category hump yards only. Also, it was assumed that one 6-hour test was performed per day with 4 and 2 hours of operation occurring during the daytime and nighttime periods, respectively.

Flat Classification Yard Noise Sources

1. Inbound/Outbound Road-Haul and Local Train Operations

As previously discussed, it was assumed that local and road-haul trains entering and leaving the classification yard complex are powered by one and three engines, respectively. Train operations were modeled as moving point sources and were assumed to take place in the receiving and departure yard components at a speed of approximately five miles per hour. The number of local and outbound road-haul train operations was combined and treated as a single source type. The number of train operations for the three flat classification yard activity categories is shown in Table N-2. It was assumed that all train operations are uniformly distributed over the daytime and nighttime periods.

2. Switch-Engines Operations: Classification, Industrial, and Roustabout

Switch engine operations were modeled as moving point sources which operate in the receiving and departure yard components at a speed of approximately four miles per hour. The rationale used in determining the operational parameters is the same as that discussed for the makeup and industrial switch engine operations in hump yards. However, for flat classification yard operations, it was assumed that only 5 cars are handled per switch engine operation.

To allow for variations in the distribution of switch engine operations for future impact assessment, switch engine operations have been modeled as two separate yard sources, one at each end of the yard complex. It is assumed that all switch engine operations are equally distributed between the two locations and that the yard operates 24-hours per day.

3. Car Impacts

Car impacts were modeled as two groups of stationary point sources located in the classification yard component. It was assumed that the total number of car impacts is equal to one-half the number of cars switched or classified per day[6]. (See Table N-2, and last section of this appendix.)

4. Idling Locomotives and Refrigeration Cars

Both idling locomotives and refrigeration cars were modeled as grouped point sources located in the classification yard component. The noise generation model and the baseline L_{dn} development procedures have been previously discussed.

The number of rows and the number of idling locomotives and refrigeration cars per row which were assumed for each flat classification yard traffic category are shown below:

TRAFFIC RATE CATEGORY	IDLING LOCOMOTIVES NUMBER OF ROWS	NUMBER OF CARS	REFRIGERATOR CARS NUMBER OF ROWS	NUMBER OF CARS
Low	2	2	2	5
Medium	3	3	4	5
High	3	3	6	5

5. Locomotive Engine Load Tests

Locomotive engine load tests were modeled as stationary point sources located in the classification yard component. As in the hump yard case, it was assumed that testing is performed in high activity category flat yards only and that one 6-hour test is conducted per day with 4 and 2 hours of operation occurring during the daytime and nighttime periods, respectively.

Flat Industrial Yard Noise Sources

1. Inbound/Outbound Road-Haul and Local Train Operations

It was assumed that local and road-haul trains entering the yard complex are powered by one engine, and departing road-haul trains are powered by three engines. Train operations were modeled as moving point sources at a speed of approximately 5 MPH. The number of local and outbound road-haul train operations were combined and treated as a single source type. All sources were assumed to operate within the yard complex. The number of road-haul and local train operations determined for the flat industrial yards is shown in Table N-3. It was assumed that all train arrivals and departures are uniformly distributed over the daytime and nighttime periods.

2. Switch Engine Operations

Switch engine operations were modeled as moving point sources at a speed of approximately four miles per hour. The rationale used in determining the operational parameters is the same as that discussed for the makeup and industrial switch engine operations in hump yards. The number of switch engine tricks per day is shown in Table N-3. It was assumed that the yard operates 24-hours per day and that all switching operations are performed at one end of the yard complex, since this type of flat yard is too small to warrant switching at both ends simultaneously.

3. Car Impacts

Car impacts were modeled as stationary point sources located at the center of the yard complex. It was assumed that the total number of car impacts is equal to the number of cars switched per day (see Table N-3) and that the yard operates 24-hours per day.

Small Industrial Flat Yard Noise Sources

1. Inbound/Outbound Road-Haul Train Operations

It was assumed that road-haul trains entering or leaving the yard complex are powered by one engine. Train operations were modeled as moving point sources at a speed of approximately five miles per hour. All sources were assumed to operate within the yard complex and it was assumed that all train arrivals and departures are uniformly distributed over the daytime and nighttime periods. The number of road-haul train operations for the small industrial yards is shown in Table N-4.

2. Switch Engine Operations

Switch engine operations were modeled as moving point sources at a speed of approximately 4 MPH. The rationale used in determining the operational parameters is the same as that discussed for industrial switch engine operations in hump yards. The number of switch engine tricks per day is shown on Table N-4. It was assumed that the yard operates 24-hours per day and that all switching operations are performed at one end of the yard complex.

3. Car Impacts

Car impacts were modeled as stationary point sources located at the center of the yard complex. It was assumed that the total number of car impacts is equal to the total number of cars switched per day (see Table N-4) and that the yard operates 24-hours per day.

Noise Propagation Attenuation Factors

Previous analyses of noise propagation losses in various types of urban areas have resulted in generalized approximations for the total attenuation with distance including air and ground absorption, and buildings acting as noise barriers. In general, these analyses appear to have been done for road traffic (line) noise sources which characteristically have most of their noise energy distributed in the 100 to 1000 Hz frequency range. The results for the composite attenuation between 100 and 500 feet (30 and 152 m) were approximately 14 dB, 12 dB and 8 dB per doubling of distance for urban high rise, urban low rise and open terrain areas, respectively.

It was considered that these "distance attenuation" relationships were not applicable to the railyard noise case due to the wider variety of noise sources (point and moving), many of which have considerably different spectral characteristics than traffic noise sources. As discussed earlier in the subsection on railyard noise sources, retarder squeal, car impacts and other sources have dominant noise energy in the 1000 to 4000 Hz range, while idling locomotives and switch engine operations produce dominant noise energy in the low frequency (100 Hz) range. The result is that air and ground absorption factors may be significantly different for the railyard noise sources than for the road traffic noise.

Therefore, an analysis was conducted to determine air and ground attenuation factors for each type of noise source in the railyards, and building insertion loss factors for the medium- and low-density land use areas surrounding rail yards. The analysis and results are presented in the following paragraphs. The resulting attenuation factors apply to the railyard noise sources and locations only, and are not likely to be appropriate for regulatory noise analyses for other products or noise sources.

Divergence Loss

The variation of noise with distance from the source because of divergence loss, i.e., spreading of noise energy over larger and larger areas, for stationary (individual and grouped) sources in the railyards is a function of 20 $\log_{10}$ (distance ratio) assuming that the sources radiate in the normal hemispherical pattern. Since the determination of L_{dn} values for the stationary sources is based on L_{eq} or SENEL values which are dependent only on noise event durations, the decrease in L_{dn} with distance is also a function of 20 $\log_{10}$ (distance ratio).

In the case of the moving sources, e.g., switch engines, L_{dn} is developed from SENEL per pass-by and the number of pass-by events. At a particular distance from the source the SENEL value is a function of the speed of the source and the maximum noise level (L_{max}) during the pass-by:[3]

$$SENEL_1 = L_{max_1} + 10 \log \left(\pi \frac{D_1}{V} \right)$$

where:

D_1 = distance from source to observer (m), and
V = source speed (m/sec).

Then at any other distance D_2:

$$SENEL_2 = L_{max_1} - 10 \log \left(\frac{D_2}{D_1} \right)^2 + 10 \log \left(\pi \frac{D_2}{V} \right)$$

However, this reduces to:

$$SENEL_2 = L_{max_1} + 10 \log \left(\pi \frac{D_1}{V} \right) - 10 \log \frac{D_2}{D_1}, \text{ or}$$

$$SENEL_2 = SENEL_1 - 10 \log \frac{D_2}{D_1}$$

Therefore, the divergence loss applicable to L_{dn} values for moving sources is a function of 10 log (distance ratio) rather than 20 log (distance ratio).

Air and Ground Absorption Factors

The railyard noise sources have been identified, or simplified, as either moving point sources or stationary (virtual point) sources. The noise level reduction with distance is a function of the type of source, (stationary or moving), and its characteristic noise spectrum. Thus, in addition to the usual divergence or spreading loss, the noise energy is dissipated in the air medium and absorbed along the ground surfaces. The air attenuation and ground absorption are dependent mainly on the predominant frequencies in the noise spectrum and also on the relative humidity and air temperature. For these analyses, it was assumed that the average conditions would be a typical day with an air temperature of 60° F and a relative humidity of 60 to 70 percent. Nominal expressions for air and ground attenuation developed by DOT, FAA, and other sources are:

$$A_{air} = \frac{2fd}{10^6}$$

$$A_{ground} = 10 \log_{10} \left(\frac{fd}{4x10^5}\right), \text{ for } fd > 4x10^5,$$

$$A_{ground} = 0, \text{ for } fd \leq 4x10^5,$$

where:

A = attenuation, dB

f = sound frequency, Hertz, and

d = distance from source, feet.

However, since the noise model must compute L_{dn} values, and since the L_{dn} noise rating scale is based on A-weighted sound levels, it is more convenient to use a combined air and ground attenuation factor representing

However, since the noise model must compute L_{dn} values, and since the L_{dn} noise rating scale is based on A-weighted sound levels, it is more convenient to use a combined air and ground attenuation factor representing the attenuation of the A-weighted noise levels with distance. Thus, the railyard noise source data base was used to obtain an average or typical noise spectrum, in terms of octave band sound levels, for each type of source. In general, the data base provided typical spectral levels at 50 or 100 feet (15 or 30 m). For each typical source the air and ground attenuation was calculated for 100 to 2000 foot (30 to 610 m) distances using the center frequency of each octave band for the f value in the equations given above. The A-weighted level at each distance was then computed from the correspondingly attenuated octave band noise levels, and the differences between the levels at the selected distances were used to determine the extra attenuation (A_{a+g}) in dB attributable to air and ground absorption. An approximation to the average extra attenuation factor $\left(1/2\left[\frac{A_{a+g}}{1000} + \frac{A_{a+g}}{2000}\right]\right)$, was obtained by inspecting the values for the source at the 1000 and 2000 foot (610 and 1220 m) distances.

A review of octave band spectra for the seven major types of railyard noise sources indicated a wide variation in the predominant noise energy frequencies. Because the level of extra attenuation increases directly with the sound frequency, as indicated by the air and ground attenuation equations shown above, the greatest noise level attenuation will occur for the noise sources whose levels are dominated by high-frequency components. The data base indicated, for example, that the noise source with the highest predominant frequencies were the retarders. The retarder screech, or squeal, sound energy is concentrated in the 2000 to 4000 Hz frequency level. Using the procedure outlined in the preceding discussion, the combined air and ground attenuation for retarder noise was calculated to be 10 dB per 1000 feet (305 m). Other noise sources such as car impacts and refrigerator cars produce A-weighted sound energy predominantly in the mid-frequency range (1000 to 2000 Hz), and the combined attenuation factors were determined to be in the 3 to 5 dB per 1000 feet(305 m) range. Locomotive sources, switch engines and road-haul engines, were generally characterized by low-frequency (<500 Hz) sound energy, and the combined attenuation factors were 1 to 2 dB per 1000 feet (305 m). The resulting combined air and ground absorption factors are shown for each noise source-type on Table B-7.

Table N-7

COMBINED AIR AND GROUND ATTENUATION FACTOR FOR MAJOR RAIL YARD NOISE SOURCES

Noise Source	Combined Air and Ground Attenuation Factor* (dB/ft)	
Retarders	0.01 (dB/ft)	0.033(dB/m)
Switch Engines	0.001	0.0033
Car Impacts	0.005	0.0016
Idling Locomotives	0.0025	.0008
Locomotive Load Tests	0.002	.0066
Refrigeration Cars	0.0035	.0115
Road-Haul Locomotives	0.002	.0066

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*Based on A-Weighted SPL

Insertion Loss Due to Buildings

The DOT railyard survey indicated that the 4000 railyards were widely distributed relative to the surrounding land use and the size of the cities where they are located. Examination of yard locations and surroundings in different cities from 20 to 30 USGS quadrangle maps indicated that relatively few railyard complexes were situated in central business districts characterized by all multi-floor buildings and high-density land use. Thus, from the yard distribution data, it was determined that noise level attenuation factors due to intervening buildings were necessary for two cases: (1) residential area with single-floor houses, and (2) residential, commercial or other area with multi-floor buildings.

Typical insertion loss factors for the first row and additional rows of buildings have been developed by many authors.[7,8] These factors were developed generally for highway traffic noise sources (line sources) and are applicable when the location of the buildings relative to the source is known.

or when the conditions are similar to those for which the factors were developed. In the general case of the railyards and their surrounds, the typical distances from the noise sources to the buildings, or the spacings between the buildings on the receiving land are not known.

Therefore, it was necessary to reexamine the insertion loss data to determine a generalized approximation for insertion loss due to buildings in the non-specific case of the railyards and their surroundings. The data used to obtain the insertion loss values in FHWA/NCHRP Reports 117 and 144 and in other sources to obtain the insertion loss values were reviewed.[7,8] When the overall conditions, including background noise effects, were taken into consideration, the expected total insertion loss for several rows of buildings was in the range 5 dB for low-density residential areas (single-floor dwellings), and 8 dB for higher-density areas of multi-floor buildings. Since the distances to the buildings are not known for railyards noises, average losses of 5 dB per 1000 feet (305 m) and 8 dB per 1000 feet (305 m) were used for the lower and higher density areas, respectively. The resulting insertion loss coefficients for each place size and population density range are listed in Table N-8.

Table N-8

BUILDING INSERTION LOSS COEFFICIENTS AS A FUNCTION OF PLACE SIZE AND AVERAGE POPULATION DENSITY RANGE

Place Size (Population)	Population Density Range (people/sq mi)	Insertion Loss Coefficient dB/ft	dB/m
<50,000 and 50,000 to 250,000	<500	0	0
	5000 to 1000	0	0
	1000 to 2000	.005	.016
	2000 to 3000	.005	.016
	3000 to 5000	.008	.026
	5000 to 7000	.008	.026
	7000 to 11000	.008	.026
>250,000	<1000	0	0
	1000 to 5000	.005	.016
	5000 to 7000	.005	.016
	7000 to 10000	.008	.026
	10000 to 15000	.008	.026
	15000 to 22000	.008	.026

Car Impact Event Rate

During the initial stages of the development of the railyard noise impact model, the only data available to indicate railcar traffic rates (and thus car coupling event rates) were in the SRI/FRA railyard study report.[2] This reference indicated only the average traffic rate (number of railcars classified per day) for low, medium and high traffic categories of hump and flat classification yards. One assumption that could be made was that the number of car impacts equaled the number of cars classified per day. However, it was known that often more than one car was "humped" or "kicked" at times.

Subsequently, during the model development additional studies of railyard configuration (EPIC analyses, see Section 4 and Appendix K) and railyard noise environments were completed.[6] Although 120 sample railyards (of all types) were examined during the EPIC analyses, no activity rate parameters were obtained.

Also, the railyard noise survey did not include any substantial data regarding yard activity parameters for correlation with measured noise levels. However, in a few instances the 24-hour noise-time history records obtained provided indications of the number of car coupling events audible at measurement locations near railcar classification areas.

Car impact noise events were identified on time-history traces at a total of 15 measurement locations covering 8 railcar classification yards (3 hump and 5 flat yards). In general, at the hump yards there was one measurement location at the master retarder (receiving) end and one at the inert retarder (departure) end of the classification area, and at the flat yards there was one measurement location near each of the opposite ends of the classification area. Unfortunately, not all noise events on the records were marked or identified, many different types of events produced similar patterns and were intermixed (in time sequence), not all of the hourly records were complete and some car impact events probably appeared on the records of both measurement locations at a yard while some car impact events may not have been recorded (due to distance or low noise levels). Therefore, there is a high degree of uncertainty associated with counting the car inpact events (spikes) on the noise-time history traces. Additionally, the sample sizes are not sufficiently large (3 hump yards out of 124, and 5 flat classification yards out of 1113) to represent the yard population with statistical confidence. Finally, in no case was the actual traffic counted at the yards on the measurement days, and in many instances the traffic category for the yards had to be inferred from auxiliary information (maps, number of tracks, etc.). However, it was considered that the use of the available data would provide some improvement in the accuracy of traffic rate estimates beyond the initial assumption that car impact rates equaled car classification rates. Thus a summary of the number of car impacts counted from the noise survey data is presented below.

Railyard Type	Railyard Name	Traffic Category	Avg. Traffic Rate (Cars/Day)	Car Impacts Per Meas. Site (Events/Day)	Counted Total (Events/Day)
Hump	Roseville	High	4000*/2390**	1:570 3:160	730
Hump	Barstow	Medium	1470**	1:375 (2:assume 200)	575
Hump	Brosnan	High	2390**	2:790 3:395	1185
Flat	Richmond	Medium	710**	1:600 3:250	850
Flat	Mays	High	1340**	1:455 3:415	950
Flat	Settegast	High	1340**	1:--- 3:---	563
Flat	Dillard	High	1340**	1:--- 3:---	645
Flat	Johnston	High	1500*/1340**	1:--- 3:---	1145
		TOTAL	12320**		6643

*Per Ref. 6
**Per Ref. 7

The average ratio of counted impacts per day to traffic category rate for both types of yards is 6643/12320 = 0.54. Therefore, based on this limited amount of data it was assumed for the noise impact model that the numer of car coupling noise events per day was equal to one-half the typical traffic rate (cars classified per day) for the respective traffic category. However, since there were no measured data at the industrial and small industrial type yards, it was assumed that for these smaller yards the number of coupling events equaled the number of railcars classified.

Distribution of Car Couplings in Railyards

There were no survey data available to indicate typical spatial distributions of railcar coupling events in classification yards, which cover relatively large areas. The results of the EPIC analyses (See Section 3) indicated the typical classification areas were 120 to 240 m (400 to 800 ft) wide and 760 to 2130 m (2500 to 7000 ft) long, and the SRI/FRA study indicated a range of 14 to 57 parallel tracks for the smaller to larger yards, respectively. It could be reasonably assumed, however, that car couplings would occur randomly, over a long time period (weeks to months), in a large portion of the classification areas. Also, examination of the railyard noise survey data discussed above provided some indication of widely separated coupling events in the classification areas. Thus, although there was insufficient data to typify coupling distributions in any detail, it was considered more reasonable to assume two virtual (concentrated event) sources rather than placing all coupling events at one point (or area). Therefore, in the case of hump and flat classification yards, car coupling events were divided into two independent noise source groups (virtual sources). Each of the smaller industrial flat yards were assumed to have one virtual source representing car coupling events.

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APPENDIX O

YARD IDENTIFICATION AND ACTIVITY RATES

Table 0-1

U.S AUTOMATED CLASSIFICATION YARDS

Company	ocation	Supplier	Year
ALS	ast St. Louis, Ill.	GE-GRS-WABCO	1965
ATSF	ueblo, Colo.	WABCO	1950
	orwith Yd., Chicago, Ill.	WABCO	1958
	astbound Argentine Yd., Kansas City, Mo.	WABCO	1969
	arstow Yd., Barstow, Calif.	WABCO-ABEX-ATSF	1976
BO	estbound Yd., Cumberland, Md.	GRS	1960
BETH STL	urns Harbor, Ind.	GRS	1969
BN	avin Yd., Minot, N. Dakota	GRS	1956
	icero, Ill.	WABCO	1957
	issoula, Montana	GRS	1967
	rth Kansas City, Mo.	WABCO	1969
	terbay Yd., Seattle, Wash.	ABEX	1969
	asco, Washington	GRS	1971
	rthtown Yd., Fridley, Minn.	GRS	1974
CO	evens, Kentucky	WABCO	1955
	nifest Yd., Russell, Kentucky	WABCO	1958
MILW	rline Yd., Milwaukee, Wis.	WABCO	1952
	nsenville, Ill.	WABCO	1953
	. Paul, Minn.	WABCO	1956
CR	B. Rutherford Yd., Rutherford, Pa.	GRS	1952
	astbound Conway, Pa.	WABCO	1955
	stbound Conway, Pa.	WABCO	1957
	ontier Yd., Buffalo, N.Y.	GRS	1957
	R. Young Yd., Elkhart, Ind.	GRS	1958
	g Four Yd., Indianapolis, Ind.	GRS	1960
	andview Columbus, Ohio	ABEX	1964
	th Street, Chicago, Ill.	ABEX	1966
	vonia, N.J.	GRS	1967
	E. Perlman Yd., Selkirk, N.Y.	GRS	1968
	ckeye Yd., Columbus, Ohio	GRS	1969

Table O-1

U.S AUTOMATED CLASSIFICATION YARDS (Continued)

Company	Location	Supplier	Year
DRGW	Grand Junction, Colo.	GRS	1953
DTI	Flat Rock Yd., Detroit, Mich.	ABEX	1967
DTS	Lang Yd., Toledo, Ohio	WABCO	1974
CR	Bison Yd., Buffalo, N.Y.	GRS	1963
EJE	Kirk Yd., Gary, Ind.	GRS	1952
ICG	Southbound Markam Yd., Chicago, Ill.	GRS	1950
	East St. Louis, Ill.	GRS	1964
IHB	Eastbound Blue Island Yd., Riverdale, Ill.	GRS	1953
LRT	Licking River Yd., Wilder, Ky.	CRS	1977
LN	Tilford Yd., Atlanta, Ga.	WABCO	1957
	Boyles Yd., Birmingham, Ala.	WABCO	1958
	Southbound DeCoursey, Kentucky	WABCO	1963
	Strawberry Yd., Louisville, Ky.	WABCO	1976
MP	Neff Yd., Kansas City, Mo.	GRS	1959
	North Little Rock, Arkansas	GRS	1962
	Centennial Yd., Ft. Worth, Texas	WABCO	1971
NW	Portsmouth, Ohio	WABCO	1953
	Bellevue, Ohio	WABCO	1967
	Roanoke, Va.	WABCO	1971
	Lamberts Point, Va.	GRS	1952
PLE	Gateway Yd., Youngstown, Ohio	WABCO	1958
RFP	Southbound Potomac Yd., Va.	WABCO	1959
	Northbound Potomac Yd., Va.	WABCO	1972
SLSF	Tennessee Yd., Memphis, Tenn.	GRS	1957
	Cherokee Yd., Tulsa, Oklahoma	GRS	1958

Table O-1

U.S AUTOMATIC CLASSIFICATION YARDS (Continued)

Company	Location	Supplier	Year
SSW	Pine Bluff Yd., Pine Bluff, Arkansas	WABCO	1958
SCL	Hamlet, N.C.	WABCO	1955
	East Bay Yd., Tampa, Fla.	WABCO	1970
	Rice Yd., Waycross, Ga.	WABCO	1976
SOU	Sevier Yd., Knoxville, Tenn.	GRS	1950
	Norris Yd., Birmingham, Ala.	GRS	1952
	De Butts Yd., Chattanooga, Tenn.	GRS	1955
	Inman Yd., Atlanta, Ga.	GRS	1957
	Brosnan Yd., Macon, Ga.	GRS	1966
	Sheffield Yd., Sheffield, Ala.	GRS	1973
	Piggy Back Yd., Atlanta, Ga.	WABCO	1973
	Linwood Yd., Salisbury, N.C.	GRS	1978
SP	Richmond, Calif.	ABEX	1964
	City of Industry, Los Angeles, Calif.	ABEX	1966
	Eugene, Oregon	WABCO	1966
	Beaumont, Texas	WABCO	1967
	West Colton, Calif.	WABCO	1973
	Strang Yd., Houston, Texas	GRS	1977
TNO	Englewood Yd., Houston, Texas	GRS	1956
TRRA	Eastbound Madison Yd., Madison, Ill.	WABCO	1974
UP	North Platte, Neb.)Bailey	WABCO	1956
	North Platte, Neb	WABCO	1968
	East Los Angeles, Calif.	GRS	1971
	Hinkle Yd., Hinkle, Oregon	GRS	1977
URR	Mon. Southern Yd., Pittsburgh, Pa.	WABCO	1954

Table O-2

ACTIVITY RATES FOR HUMP CLASSIFICATION YARDS*

	Traffic Rate Category		
Activity Parameter	Low (<1000)**	Medium (1000 to 2000)**	High (>2000)**
No. of Classification Tracks	26	43	57
Receiving Tracks	11	11	13
Departure Tracks	9	12	14
Standing Capacity of Classification Yard	1447	1519	2443
Standing Capacity of Receiving Yard	977	1111	1545
Standing Capacity of Departure Yard	862	969	1594
Cars Classified Per Day	689	1468	2386
Local Cars Dispatched Per Day	86	250	315
Industrial Cars Dispatched Per Day	74	86	220
Road-Haul Cars Dispatched Per Day	632	1050	2297
Cars Reclassified Per Day	94	195	275
Cars Weighed Per Day	74	42	149
Cars Repaired Per Day	38	43	153
Trailers & Containers Loaded or Unloaded Per Day	36	30	39
Average Time In Yard (Hours)	21	22	22
Inbound Road-Haul Trains Per Day	8	14	27
Outbound Road-Haul Trains Per Day	8	14	25
Local Trains Dispatched Per Day	2	3	5
Hump Engine Work Shifts Per Day	3	5	6
Makeup Engine Work Shifts Per Day	3	6	11
Industrial Engine Work Shifts Per Day	2	2	10
Roustabout Engine Work Shifts Per Day	2	1	4

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*Railroad Classification Yard Technology, A Survey and Assessment, S. J. Petracek, Stanford Research Institute, Final Report, #FRA-ORD-76/304 for DOT, January 1977.

**Range of number of rail cars classified per day.

Table 0-3

ACTIVITY RATES FOR FLAT CLASSIFICATION YARDS*

Activity Parameter	Traffic Rate Category Low (<500)**	 Medium (500 to 1000)**	 High (>1000)**
No. of Classification Tracks	14	20	25
Standing Capacity of Classification Yard	643	983	1185
Cars Classified Per Day	288	711	1344
Local Cars Dispatched Per Day	72	93	182
Industrial Cars Dispatched Per Day	47	69	121
Road-Haul Cars Dispatched Per Day	218	472	942
Cars Reclassified Per Day	60	196	348
Cars Weighed Per Day	14	21	16
Cars Repaired Per Day	13	28	31
Trailers & Containers Loaded or Unloaded Per Day	22	22	76
Average Time In Yard (Hours)	19	19	18
Inbound Road-Haul Trains Per Day	3	6	10
Outbound Road-Haul Trains Per Day	3	7	11
Local Trains Dispatched Per Day	2	3	2
Industrial Engine Work Shifts Per Day	2	3	4
Roustabout Engine Work Shifts Per Day	0	1	2
Switch Engine Work Shifts Per Day	4	7	10

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*Railroad Classification Yard Technology, A Survey and Assessment, S. J. Petrocek, Stanford Research Institute, Final Report, #FRA-ORD-76/304 for DOT, January 1977.

**Range of number of rail cars classified per day.

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